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THE POSSIBILITY OF PRECANCEROUS ORAL LESIONS FROM ELECTRICAL CAUSES*

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and
HERBERT I. GOODALE
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AMONG the many sources of irritation which can be considered as possible factors in the production of precancerous and cancerous lesions in the oral cavity may be included the electrical irritation effect produced by some combinations of metals used for filling teeth and constructing other dental restorations.

Ewing[1] calls attention to this possibility, and Meisburger[2] makes reference to the subject of "galvanism." Although Bloodgood[3] does not definitely mention electro-potential, he says, "Now and then a patch of leukoplakia can be produced by the irritation of a tooth, especially one with a metallic filling." Lain[4] mentions the possibility of electrical discharges between dissimilar metals which in the presence of saliva as an electrolyte would constitute a galvanic cell. He further attempts to show the presence of electrical currents by inserting a sensitive ammeter between the restorations and obtains deflections in his meter showing current values of from 1 to 40 micro-amperes.

In an endeavor to determine the part played by the metallic restorations resulting in electrical action in cancerous and precancerous lesions, the apparatus shown in Fig. 1 was constructed and used on fifty people. This apparatus is essentially the same as used by Lain except that a galvanometer of greater sensitivity than a micro-ammeter was used in conjunction with several variable shunts as pictured in Fig. 1. The wiring diagram is shown in Fig. 2. Currents ranging from 0.1 to 1000 micro-amperes could be measured by using the

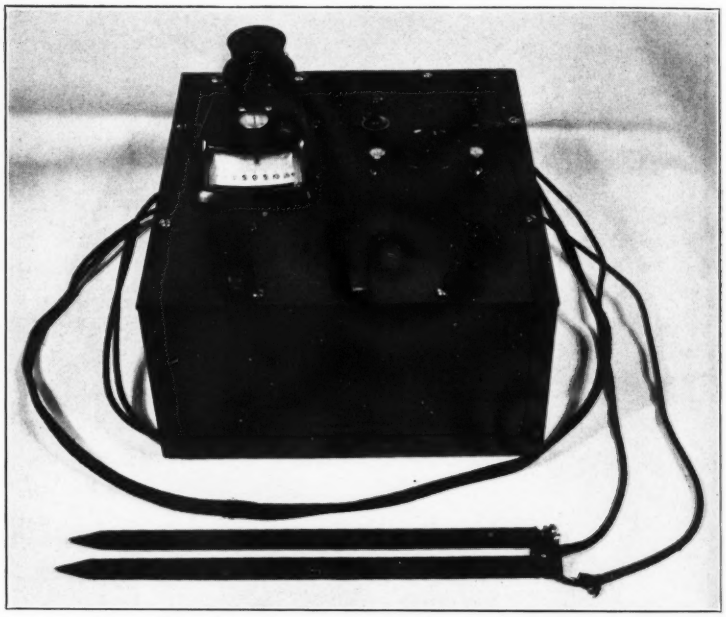

Fig. 1—Measuring instrument; galvanometer and shunts with the contactors in front of box.

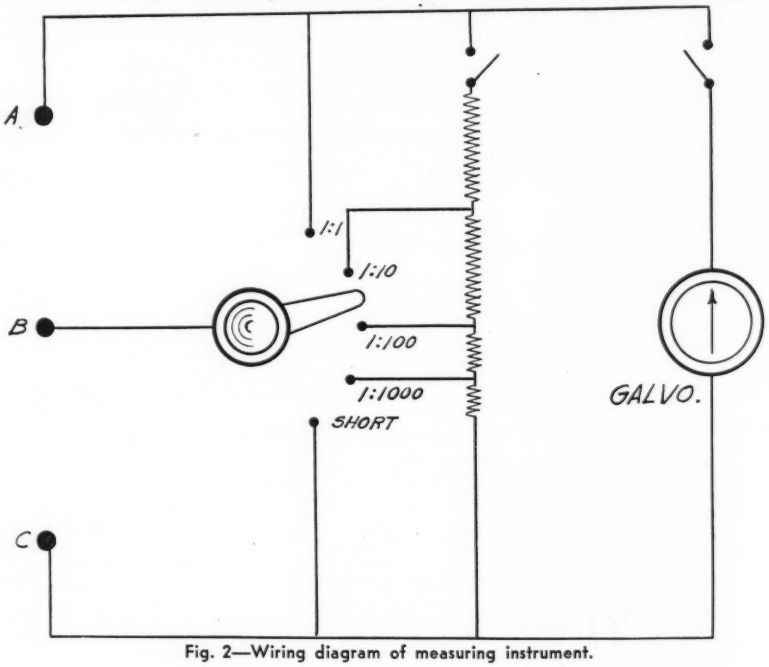

Fig. 2—Wiring diagram of measuring instrument.

*From the State Institute for the Study of Malignant Diseases, Buffalo, New York, Burton T. Simpson, M.D., Director.

[1]Ewing, James: Cancer of the Mouth, Chicago Dent. Soc. Bull., June 21, 1929.

[2]Meisburger, L. H.: Lecture Notes on Dental Pathology, University of Buffalo Dental School, 1925.

[3]Bloodgood, J. C.: Precancerous Lesions of the Oral Cavity, J. A. D. A. **16**:1352-1367 (August) 1929.

[4]Lain, E. S.: Chemical and Electrolytic Lesions of the Mouth Caused by Artificial Dentures, Arch. Dermat. & Syph. **25**:21-23 (January) 1932.

RESULTS OF MEASUREMENTS WITH A GALVANOMETER IN FORTY-EIGHT CASES

Case	Meter Circuit*	Micro-Amperes	Observations
1	G. S. to A.	5	No complaint
	A. to A.(silver nitrate)	50	
	A. to A.	7	
	A. to A.	8	
2	G. I. to A. (1)**	10	No complaint
	G. I. to A. (2)	6	
	A. to A. (2)	3	
3	G. B. to A. (2)	5	Sore present adjacent to lower amalgam
	G. B. to A. (1)	17	
4	G. S. to A. (1)	13	Metallic taste
	G. S. to A. (1)	1	
	A. (1) to A. (2)	12	
	A. (1) to A. (3)	6	
5	A. (1) to A. (2)	5	No complaint; history of Vincent's infection
	A. (2) to A. (3)	8	
	A. (1) to A. (3)	10	
	A. (2) to A. (4)	4	
	A. (1) to A. (4)	5	
6	G. S. to A.	10	No complaint
	G. S. to A.	25	
	G. S. to G. solder on B.	3.5	
7	A.to G. S. (1)	15	Metallic taste
	A.to G. S. (2)	10	
8	G. I. to A. (1)	5	Metallic taste
	G. S. to A. 2)	10	
	A. (3) to A. (4)	5	
	G. I. to G. S.	5	
9	A. to G. S.	15	No complaint
	A. to G. I.	10	
	G. I. to G. S.	3	
10	A. to A.	5	No complaint
	G. to A., molar	12	
	G. to A., bicuspid	10	
	G. to G.	.....	
	G. to A.	6	
	G. to A.	1	
11	G. S. to A. (1)	10	Metallic taste
	G. S. to A. (2)	10	
	A. (1) to A. (2)	8	
	A. (2) to A. (3)	3	
	A. (1) to A. (3)	5	
12	G. I. to A. (1)	40	No complaint
	G. S. cap to A. (1)	60	
	G.I. to G. S.	11	
	G. I. to A. (2)	30	
	G. S. cap to A. (2)	15	
	A.(1) to A. (2)	4	
13	G. I. to A. (1)	40	No complaint
	G. S. cap to A. (1)	60	
	G.I. to G. S.	11	
	G. I. to A. (2)	30	
	G. S. cap to A. (2)	15	
	A. (1) to A. (2)	4	
14	G. B. to A. (1)	15	No complaint
	G. B. to A. (2)	10	
	A. (1) to A. (2)	4	
15	G. anterior B. to G. S.	0	No other restoration
16	G. I. to A. (1)	8	Metallic taste
	A. (1) to A. (2)	10	
	G. I. to A. (2)	0	
17	A. (1) to A. (2)	10	Metallic taste
	A. (1) to A. (3)	4	
	A. (2) to A. (3)	4	
18	G. (1) to G. (2)	1.5	No complaint
	G. (2) to G. (3)	1.5	
	G. (1) to G. (3)	1.0	
19	G. P. D. to A. (1)	35.0	Recurrent Vincent's infection
	G.P. D. to A. (2)	32.5	Metallic taste
	A.(1) to A. (2)	3.5	
	A. (1) to A. (3)	8.0	
20	G. S. to A. (1)	40	No complaint
	G. S. to A. (2)	40	
	A. (1) to A. (2)	10	
21	G. S. to large A.	60	Bad taste
	G. S. to small A.	15	
	G. S. to G. I.	3	
22	G. I. to A.	4	No complaint
	A. to A.(silver nitrate)	5	
23	G. B. to A. (1)	15	No complaint
	A. (1) to A. (2)	5	
	G. B. to A. (2)	17	
24	G. S. to A.	30	Metallic taste
	A. to A.	15	
	G. S. to G. backing	3	
25	G. B. to A. (1)	12	No complaint
	G. B. to A. (2)	10	
	A. to A.	4	
	G. B. to G. F.	3	
26	G. to A. (1)	2	No complaint
	A. (1) to A. (2)	2	
	A. (2) to A. (3)	0.4	
	A. (1) to A. (3)	0.7	
27	A. to A.	2.0	No complaint
	A. to A.	4.5	
	G. to A.	15.0	
	G. to A.	12.0	
28	A. (1) to A. (2)	10	Sore tongue and at times a metallic taste
	A. (1) to A. (3)	6	
	A. (1) to G. S.	8	
29	G. S. to A. (1)	50	No complaint
	G. S. to A. (2)	40	
	A. (1) to A. (2)	12	
	G. S. to G. I.	10	
30	A. (1) to G. S.	13	No complaint
	A. (2) to G. S.	3	
	A. (1) to A. (2)	8	
31	A. (1) to G. S.	30	No complaint
	A. (2) to G. backing	50	
	A. (1) to A. (2)	20	
32	A. (1) to A. (2)	4	No complaint
	A. (1) to A. (3)	5	
	A. (4) to A. (5)	15	
	A. (6) to A. (7)	18	
33	G. to Al. V.	2.5	No complaint
	A. (1) to A. (2)	1.5	
	A. (2) to A. (3)	1.0	
	A. (1) to A. (3)	4.0	
	A. (1) to A. (4)	4.0	
	A. (3) to A. (4)	1.0	
	A. (1) to Al. V.	4.0	
34	A. to G. S.	20	No complaint
	A. (1) to A. (2)	1	
	A. (2) to A. (3)	5	
	A. (1) to A. (3)	0.5	
35	A. (1) to G. S.	4	Metallic taste around G. B.
	A. (2) to G. S.	10	
	G. S. to A. (silver nitrate)	12	
36	G.I. to A. (1)	40	No complaint
	G. I. to A. (2)	30	
	A. (1) to A. (2)	5	
37	G. S. (1) to G. S.(2)	10	No complaint
	G. S. (1) to A.	8	
	G. S. (2) to A.	12	
38	G. B. to G. S.	00	No complaint
39	F. D. (nonmetallic)	00	No complaint
40	V. D. with Al and Cu dust to G. B.	slight vibration	No complaint
41	A. to A.	25	No complaint
42	A. (1) to A. (2)	0.75	No complaint
	A. (1) to A. (3)	0.50	
	A. (2) to A. (3)	0.25	
43	A. (1) to A. (2)	4	Burning sensation in the palatal gum region
	A. (1) to A. (3)	15	
	A.(4) to A. (5)	4	
	A. (3) to G. clasp	15	
44	G. B. (1) to G. B. (2)	5	Extensive thick leukoplakia on both cheeks in molar region
	G. B. (1) to G. B. (3)	7	
45	G. to A. (1)	12	No complaint
	A. (1) to A. (2)	5	
	A. (2) to A. (3)	12	
	A. (1) to A. (3)	4	
	A. (1) to A. (silver nitrate)	140	
	A. (2) to A. (silver nitrate)	80	
46	G.to A. (1)	10	No complaint
	A. (1) to A. (2)	12	
	A. (2) to A. (3)	15	
	A. (1) to A. (3)	12	
47	Al. V. to A.	7.5	No complaint
	Al. V. to G. clasp	1.0	
48	A. (1) to A. (2)	5	No complaint
	A. (3) to A. (4)	5	
	A. (5) to A. (1)	5	
	A. (6) to A. (3)	8	
	A. (7) to A. (1)	3	

*In the table the symbols are used to represent the following:
G. S., gold shell (equals gold crown)
G. I., gold inlay
A., amalgam
G. B., gold bridge; B., bridge
G. P. D., gold partial denture
G. F., gold foil
Al. V., aluminum vulcanite
Al, aluminum; Cu, copper
F. D., full denture

**The numbers in parentheses indicate different restorations observed, such as restoration 1, 2, 3, etc.; that is, each number in parenthesis represents a different restoration.

various shunts. In order to insert this meter between the restorations, contactors consisting of platinum needle points were mounted in bakelite handles as shown in Fig. 1. These were connected to terminals *B* and *C* (Fig. 2). The results of the measurements made on both the personnel and patients at the State Institute for the Study of Malignant Diseases are presented in the accompanying table.

As shown in the accompanying table of the forty-eight cases studied, eleven patients complained of metallic taste, one patient of sore tongue, one complained of a burning sensation of the palate, one patient complained of soreness opposite an amalgam restoration, two complained of recurring Vincent's infections, and one patient showed definite leukoplakia of both cheeks. Thirty-three patients were symptom free.

The table shows clearly that the possibilities for electrical action in the mouth exist and can be demonstrated with such an instrument, because we were able to detect a flow of current not only between metals of two different potentialities but also between alloys of the same type; namely, amalgam to amalgam, and gold to gold. This is contrary to Lain's observations, for he was unable to detect any deflection in the meter between gold restorations and only a slight deflection of the needle with amalgam to amalgam. The fact that gold is alloyed with other metals offers the explanation why potentials were produced in these restorations and why galvanometer readings could be obtained. The same applies to amalgam restorations.

The United States Bureau of Standards[5] has investigated a number of alloys intended for use in bars, clasps, inlays, crowns, partial dentures and full dentures, and says that as many as nine of the following metals were found in a single alloy: gold, silver, platinum, palladium, iridium, copper, zinc, tin, nickel, iron, manganese, magnesium, and rhodium. It is further apparent from the table that there is no connection between the amount of current measured and the severity of the symptoms for in some cases a large current was not associated with a change while in others a small reading accompanied a definite complaint.

The measurements given in the table represent initial or maximum values. These, within five seconds, dropped to a steady value, approximately from 10 to 20 per cent of the initial value.

As mentioned in a preceding paragraph, currents of the order obtained show that the possibilities of electrical action are present. By that is meant, what is measured is not necessarily the current that is flowing through the mouth continuously, nor is it any proof that an electrical current does flow from one restoration to another, but the readings indicate that an electrical potential exists between two metals in the mouth and when these are connected, as through the meter, current flows. In order to have current flow through the mouth it is necessary to have an external circuit. As Lain points out, the elements of a galvanic cell are present; namely, two metals of different potentials bathed in an electrolyte, the saliva. As in a galvanic cell, however, no current flows until the two metals are connected externally by a conducting medium. It is possible to conceive an external circuit in the mouth through the soft tissues where contact is made between the soft tissues and the metals. To prove the existence of such a circuit, however, would be difficult. In fact it is doubtful that such a circuit exists because of the nature of the initial and final readings of the meter. This phenomenon of high initial value dropping to a steady value is typical of a galvanic cell when that cell is not in use; namely, when no external circuit exists prior to the establishment of the meter circuit.

Fig. 3—Small leukoplakia area on left inner cheek adjacent to large amalgam restoration in lower second molar.

Furthermore, the current has been measured when the meter is between a gold and an amalgam restoration where neither restoration is in contact with soft tissue, but the two could simultaneously be touched by the tongue. The first measurement when the tongue was not in contact with the restorations gave an initial value of 15 micro-amperes, a final reading of 1.5 micro-amperes. The contactors were removed for a moment and then another measurement was made with the tongue touching the restorations. The same initial and final readings were obtained. This indicates that in this case at least there is no current flowing through the tongue.

If one assumes that such a circuit through the soft tissues does exist (one might call it the hypothetical external circuit), the question arises, does the measured current bear any relation to the hypothetical current? The answer is that it does not, for the following reasons: In measuring the current in any electrical system, it is necessary to interrupt or open the circuit and insert an ammeter in the opening. Obviously, our meter is not and cannot be placed in the external circuit. When a meter is inserted, as was done for the measurements given in the accompanying table, a circuit is merely being established which is parallel to the hypothetical circuit and which would bear a simple relation to it; namely, the relation of parallel circuits, provided the source of the current were the same in the two. That this source is not the same is apparent since the current through the soft tissues would depend on the surface of the metals in contact with it, while the current through the meter depends not on the total surface of the restoration but on the surface of contact between the contactors and the restorations, provided no further potentials are set up at the point of contact. This is assuming that the

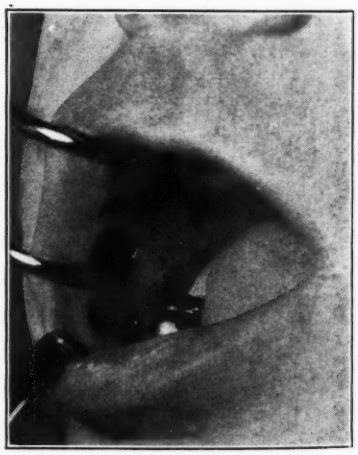

Fig. 4—Small leukoplakia area on right inner cheek adjacent to gold shell crowns present on lower first and second molars.

[5]Coleman, R. L.: Physical Properties of Dental Materials, U. S. Dept. Commerce, Bureau of Standards, Research Paper No. 32, December, 1928.

same relations hold for the two circuits, such as the electrolyte and potential.

In order to have this simple relation between current and resistance for parallel circuits hold, it would be necessary to know the resistance of the hypothetical circuit. Because of these unknown factors, the currents measured as for the table are of no significance quantitatively. Furthermore, for the same reasons that an electrical potential exists between the saliva and the metallic restoration, it would also exist between the saliva and the metal of the contactors. If they are pure metal of the same kind, however, no current should flow. Our contactors were made from the same piece of a platinum iridium alloy; yet, when placed on the tongue, several micro-amperes of current flowed through the meter. Presumably, at the point of contact there was a slight difference in the composition or physical characteristics of the two points. This factor would also influence the reading in the meter circuit, which further indicates the difficulties involved.

We are of the opinion that while a galvanic cell may exist in the mouth, little or no current flows from one dental restoration to another; however, the nature of the metallic restorations when alloys are used is such that some pathologic disturbances in the mouth may be ascribed to "local electrical action." This phenomenon of "local action" may be described as follows: An alloy, such as copper and gold, is merely a physical mixture of separate and distinct crystals of each constituent, and when these crystals coexist on the surface of a restoration there will be potential differences between them and the saliva so that current will flow, thus constituting a minute galvanic cell. In this instance, the external circuit is the restoration itself and the internal circuit is through the saliva which may or may not include soft tissue. Bloodgood's[8] observation is probably one of such action.

The current generated by each of these microscopic cells is, of course, minute, but if one considers that there may be thousands of these cells on the surface of one restoration, and that they are working continuously, it can easily be imagined that considerable current is generated and that the accumulated products of electrolysis may be sufficient to produce definite changes in the adjacent soft tissues.

If local action or any electrical current generated in the mouth were responsible for changes in the soft tissues, however, a much greater number of lesions might be expected to occur than are actually found; doubtless, therefore, there are other factors, such as hydrogen-ion concentration, cataphoresis, conductivity, and chemical composition of the saliva, which influence the generation of currents by local action. It is intended to carry out in the future work investigating these factors.

Conclusions

1. Our observations as well as those of other investigators indicate the possibility of production of benign, precancerous, and malignant oral lesions from the effect of electrical irritation of some combinations of metals used for restoring lost tooth structure.

2. Local action, as explained previously in the article, is of more consequence as an exciting etiologic factor in the production of such lesions than the possibility of the flow of current from one restoration to another.

3. The influence exerted by other factors, such as hydrogen-ion concentration, conductivity, cataphoresis, and chemical composition of the saliva, on local action is of great importance.

494 Franklin Street.

Electrogalvanic Lesions—*Lain*

I. NEWLY DISCOVERED ORAL CAVITY PHENOMENON:

"The human saliva is a good electrolyte and dissimilar metallic dentures* constitute the necessary electrodes; therefore, within every oral cavity containing dissimilar metallic dentures there is a complete galvanic battery."

II. SYMPTOMS

A. Objective—Changes in Metallic Dentures
   1. Discoloration
   2. Areas of erosion
   3. Disintegration
   4. Loosening of restorations
   5. Possible maladjustment of dentures

B. Objective—Changes in Oral Tissues
   1. Acute or chronic inflammatory, blanched or grayish patches, erosions, or ulcers
   2. Leukoplakia on the gingival or buccal membranes beneath, adjacent to, or surrounding the metallic dentures
   3. Metallic pigmentation of the mucous membranes

C. Subjective
   1. Metallic or salty taste
   2. Increased salivary secretion
   3. Burning tongue
   4. Dryness or tickling sensation in the throat
   5. Nerve soreness, nerve shocks, nervous irritability
   6. Indigestion and loss of weight
   7. Pathogenic changes in the blood and kidneys causing hyperplasia and leukoplakia of the soft tissue which may finally become malignant in extreme cases in which the metallic restorations are of radically different electropotentialities

III. FACTORS INFLUENCING ELECTRIC CURRENT

A. Total surface or volume of the dissimilar metals
B. Chemical variation of the saliva
C. Resistance of tissues and distance between dentures
D. Duration—time since the restoration of the first and the subsequent dissimilar dentures
E. Relative position of the dissimilar metals in the electromotor series (most important)

IV. CONCLUSIONS

A. Infections, tobacco, and other causes of oral lesions must first be eliminated before a positive diagnosis of electrogalvanic phenomenon is made, although these other causes may augment electrogalvanic injuries.
B. Positive cases of electrogalvanic injuries are promptly relieved by removal of the offending dentures and substituting others that are of uniform electropotentiality.
C. In order to avoid the serious pathologic changes resulting from the electrogalvanic phenomenon, manufacturing dental laboratories are urged to offer to the profession satisfactory denture materials that are of the same electropotentiality.

*Editor's Note: In this communication the author uses the term "dentures" in a sense not usually accepted as good dental usage; that is, he includes all metal restorations, plates, bridges, crowns, or fillings under the term "dentures."

—Lain, E. S.: Electrogalvanic Lesions of the Oral Cavity Produced by Metallic Dentures, J.A.M.A. 100:717 (March 11) 1933.

A NEW FLAP FORM FOR ROOT RESECTION SURGERY

M. HILLEL FELDMAN, D.D.S.
New York

THE usual flap form for root resection hitherto employed has been either a box type of incision, such as is shown in Fig. 1, or a crescentic incision (Fig. 2). In both these incisions, it has been my experience that there is a resulting numbness which persists for from six months to nine or ten months in that area between the cross incision and the gingival border. This is by no means pleasant. It has also been my experience that in reflecting the flap upward to expose the surgical radius around the apex to be resected there is much tension brought about by the retractor. The cross incision, whether it is the box form or the crescent, severs minor blood vessels, and this causes excessive hemorrhage which confuses the operator.

I have, therefore, decided to make root resection flaps directly from the gingival border, extending them upward to the buccal fold as shown in Fig. 3. The lateral incisions should flare upward rather generously, because the periapical disease may be so extensive as to require wide curettement, and the periapical disease may pass beyond the line of incision.

The reflection of the mucoperiosteum as shown in Fig. 4 is made with a periosteotome and held back with the broad end of the instrument without causing any tension by traction. There is less possibility of pinching of the lip if the flap is held back in this manner.

The return of the flap to the original points of detachment is done with one suture at each gingival angle. Healing is prompt, and not only is there an absence of numbness, but there is no scar remaining on the labial aspect. Within a short time, one cannot detect the slightest evidence that an operation was performed.

In one instance I was able to discover a perforation of the root wall and labial alveolar plate by virtue of this type of flap. Had the more commonly used form of incision been employed, this would not have been possible, as the perforation was located below the point at which the cross incision would ordinarily have been made.

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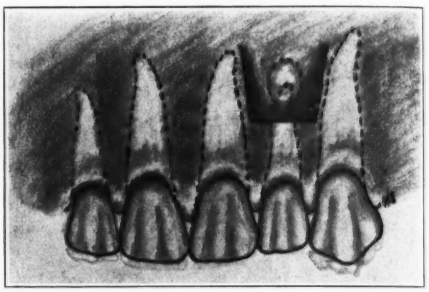


Fig. 1—Box type incision for root resection.

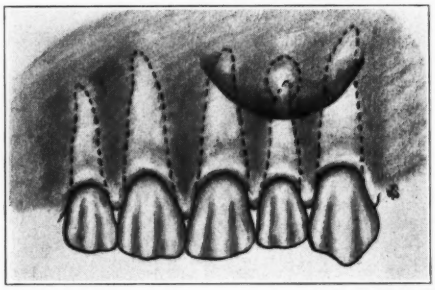


Fig. 2—Crescentic incision.

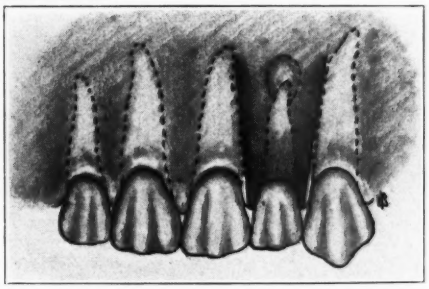


Fig. 3—Root resection flap extending directly from the gingival border upward to the buccal fold.

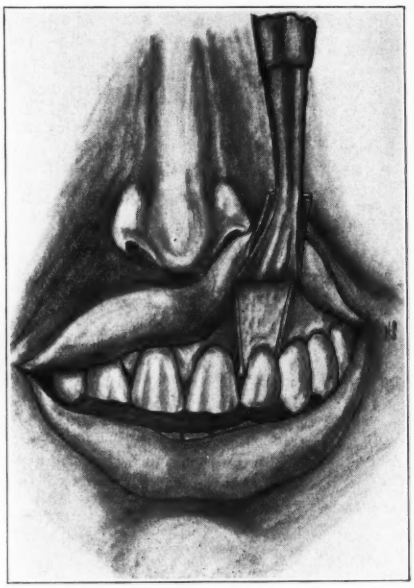


Fig. 4—Reflection of mucoperiosteum.

WHY DENTAL CARIES WITH MODERN CIVILIZATIONS?*

II. FIELD STUDIES IN PRIMITIVE VALAIS (WALLIS) DISTRICTS, SWITZERLAND

WESTON A. PRICE, D.D.S., M.S., F.A.C.D.
Cleveland, Ohio

SINCE physical isolation provides practically the only condition for compelling human beings to live on natural foods, one logically thinks of the rugged country in southern Switzerland as furnishing a variety of settlements in which Nature has been able to fondle her children undisturbed by modern civilization. In the summer of 1931 I succeeded in locating and visiting a group of people living in protected isolation in the Loetschental valley, and it seemed important to extend these studies to other districts to ascertain whether similar conditions would be found. Consequently in 1932 I returned to Switzerland to examine further the people in the Loetschental valley and to obtain detailed data on individual physical characteristics and dental conditions. For this purpose samples of saliva were obtained for chemical analysis and for estimating the levels of immunity on this basis. In the March issue of THE DENTAL DIGEST I have presented general information regarding the Loetschental valley.

I inquired of many persons regarding the most favorable districts in which to make further search to find groups of people living in protected isolation because of their physical environment, and decided to study some special high alpine watersheds between the Rhone valley and Italy. The Canton of Wallis (Valais) is bordered on the west by French speaking people, Italian speaking people on the south, and German speaking on the east and north. I was fortunate again in having the assistance of Mrs. Price in studying these people. I had as guides and interpreters in Wallis Doctor Adolf Roos for part of the territory and Doctor Alfred Gysi for all of this territory. Since alpine mountain climbing has been one of Doctor Gysi's hobbies throughout his life he has an encyclopedic knowledge of alpine flora and he makes a charming traveling companion. Our first expedition was into the valley of the Visp which is a great gorge extending southward from the Rhone River dividing into two gorges, one going to the Saas Fee country and the other to the vicinity of the Matterhorn with its almost spirelike pinnacle lifting itself above the surrounding snow-capped mountains and visible from eminences in all directions as one of the mightiest and most sublime spectacles in the world. It was one of the last mountains of Europe to be scaled by man. One has not seen the full majesty of the Alps if he has not seen the Matterhorn.

We left the mountain railroad, which makes many of the grades with the cog system, at the town of St. Nicholas and climbed the mountain trail to an isolated settlement, on the east bank of the Mattervisp River, called Grachen, a five hour journey. The settlement is snuggled on a shelf high above the east side of the river where it is exposed to southern sunshine and enjoys a unique isolation because of its physical inaccessibility. An examination made of the children in this community showed that only 2.3 teeth out of every hundred had been attacked by tooth decay.

The hardihood of the people is splendidly illustrated in Fig. 7 which shows a woman of 62 years carrying an enormous load of rye on her back. We met her later and talked to her and found that she was extraordinarily well developed and well preserved. She showed us her lovely grandchildren who had fine physiques and facial development.

The rye is so precious that the heads are protected while being carried by wrapping them in a large canvas so that not a kernel will be lost. The rye is thrashed by hand and ground in stone mills which were formerly hand-turned like the one shown in Fig. 3. Recently water turbines have been installed. Water power is abundant. The grinding is done for the people of the mountain side in these water-driven mills. Only whole rye flour is available. Each household takes turns in using the community bake oven which is shown in Fig. 4. A month's supply of entire rye bread is baked at a time for one family.

Here again the cows were away in the midsummer, pasturing up near the glaciers. Grachen has an altitude of about 5000 feet. The church at Grachen was built several hundred years ago. We were shown an embossed certificate of honor and privilege extended to a group of about 120 people who had originally built the edifice. We were given valued assistance by the local priest and facilities in his spacious and well kept rooms for making our studies of the children.

From Grachen we returned to St. Nicholas and proceeded down the valley by train for another steep ascent of several hours to the hamlet of Visperterminen on the east side of the mountain above the Visp River, below the junction of the Mattervisp and Saaservisp. This community is composed of about 1600 people living on a sheltered shelf high above the river valley. The view from this position is indescribably beautiful. It is a little below the timber line of this and the surrounding mountains. Majestic snow-clad peaks and precipitous mountains dot the horizon and shade off into winding gorges which mark the course of wandering streams several thousand feet below our vantage point. It is a place to stop and ponder as is suggested by Fig. 5. Doctor Gysi's friends will recognize him in the picture.

It is impossible for photographs adequately to reveal the physical relationship of these two communities. In Fig. 7 the patches of rye standing in shocks are about 3000 feet above the river and roadway shown in the winding ravine. The snow-capped mountains in the distance are from fifty to a hundred miles away. The gradations in climate range in the

*These reports are complementary to a detailed study to be published in book form which will deal with the etiology and control of dental caries and associated degenerations.

summer from a tropical temperature in protected nooks in the daytime to sub-zero weather with raging blizzards at night on the high mountains. It is a place where human stamina can be tempered to meet all the vicissitudes of life.

The village consists of a group of characteristically designed Swiss chalets clustered in a nook on the mountain side. The church stands out as a beacon visible from mountains in all directions. Visperterminen is unique in many respects. Notwithstanding its relative proximity to civilization which is only a few hours journey from the thoroughfare of the Rhone valley, it has enjoyed isolation and opportunity for maintaining its characteristic primitive social and civil life. We were greeted here by the President of the village who graciously opened the school house and sent messengers to have the children of the community promptly come to the school building in order that we might make such studies as we desired. This study included a physical examination of the teeth and of the general development of the children, the making of photographic records, obtaining saliva samples, as in each of the other places, and also, a detailed study of the nutrition. We also obtained foods for chemical analysis.

The people of Visperterminen have the unique distinction of owning land in the lower part of the mountain on which they maintain vineyards to supply wine for this community. They have the highest vineyards of Europe, which are grown on banks that are often so steep that one wonders how the tillers of the soil or the gatherers of the fruit can maintain their hold on the precarious and shifting footing. Each terrace has a trench near its lower retaining wall to catch the soil that is washed down each year and this soil must be carried back in baskets to the upper boundary of the plot. This is all done by human power. The vineyards afforded them such additional nutrition as would be furnished by wine and the fruit minerals and vitamins which the two previous groups we studied at Loetschental and Grachen did not have the privilege to obtain.

This additional nutrition had particular interest and importance because of the opportunity for obtaining vitamin C which has been thought by some authorities to be of special importance both for the prevention of dental caries and for the health of the gums. It is of particular interest in the study of the incidence of tooth decay in Visperterminen where these additional factors were made available by the wine that these additions had not provided a higher immunity to tooth decay nor had they provided a better condition of health for gingival tissues than previously found. In each one hundred teeth examined there were 5.2 found to have been attacked at some time with dental caries. Here again the nutrition consisted of rye almost exclusively as the cereal and of dairy products, with meat about once a week. Limited green foods were had during the summer. The general custom is to have a sheep dressed and distributed to a group of families thus providing each family with a ration of meat for one day a week, usually Sunday. The bones and scraps are utilized for making soups to be used during the week. The children have goat's milk in the summer when the cows are away in the higher pastures near the snow line. Certain members of the families go to the higher pastures with the cows and make cheese for the coming winter's use.

The important part played by the goat and the high esteem in which it is held by the people is interesting. This is indicated in Fig. 6. The goats go out to the pasture in the early morning at the break of day after they have been milked. The flocks of the village are shepherded by one or two boys. Each family takes turns at shepherding the flocks for a day. The boys are not alone for they are with their intimate friends, the goats. They see a different moving picture every day in the changing moods of the monarch peaks as they are kissed from time to time by the drifting billowy clouds. This is the school in which poets are made and symphonies conceived. In the twilight of the evening after the sun has set and the shadows are deepening the bells of the goats will be heard tinkling down the mountain side as they are driven homeward by the whistling and caroling young herders. As they arrive the children of the village rush out to meet them and find the pets of their home and lovingly throw their arms about the goats' necks. The greeting is one of affection on the part of the goats apparently as well as of the children. The goats are then corralled into a large room constituting the first floor of a building in which the two hundred goats are crowded apparently so close together that they cannot lie down.

It is now dusk and someone from each household comes to milk the goats. It is a beautiful sight and one long to be remembered to see the way in which each goat is selected from the dark enclosure by simply having its name called by the member of the household, usually the mother, who is to do the milking. The goat answers to its name with an affectionate bleat and immediately struggles to reach the gate to get out to be milked. Often there is so great a pressure about the door that it is impossible for the goat to reach the exit, whereupon it gives a cry of trouble. Frequently it is necessary in assisting the goat literally to drag it by the horns over the backs of the others to the outdoors where it is led to a delicious morsel of some plant or other food which it eats with evident relish while being milked. After this the goat is put back into the corral until morning. Truly these goats perform a beneficial mission in that they act as transformers for carrying the activators built by sunshine into the foods for the boys and girls, thus providing the battery power which makes it possible for them to utilize the fuel that is so abundantly supplied to them in their rye bread and dairy products.

It will at once be seen that the problem of identifying these goats or the cattle for establishing individual ownership would be a considerable one where the stock of all are pastured in common herds. It was interesting to us to observe how this problem was met. The President of the village has what is called a tessel which is a string of manikins in imitation of goats or cattle made of wood and leather. Every stock owner must provide a manikin to be left in the safe keeping of the President of the village with whom it is registered. It carries on it the individual markings that this member of the colony agrees to put on every member of his animal stock. The marking may be a hole punched in the left ear or a slit in the right ear or any combination of such brandings as is desired. Thereafter all animals carrying that brand are the property of the person who registered that mark; similarly any animals that do not have this individual brand cannot be claimed by him. This sacred instrument of ownership is carefully guarded.

As one stands in profound admiration before the stalwart physical development and high moral character of these sturdy mountaineers he cannot but be impressed by the superior type of manhood, womanhood, and childhood that Nature has been able to produce when given a suitable diet and suitable environment. Surely here

Fig. 1

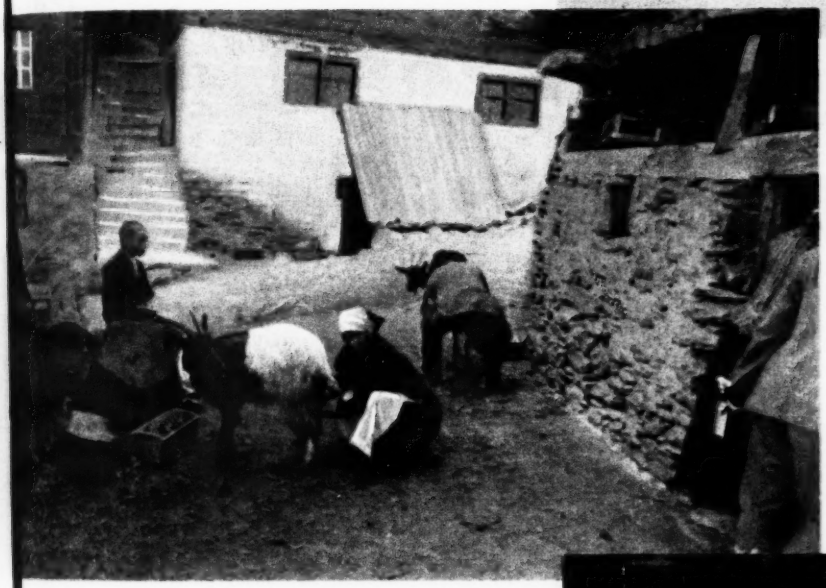


Fig. 2

Figs. 1 and 2—The goats are the route of the minerals to many of the dwellers in the high Alps whose teeth do not decay. They collect the activators into which the plants transform the radiant energy.

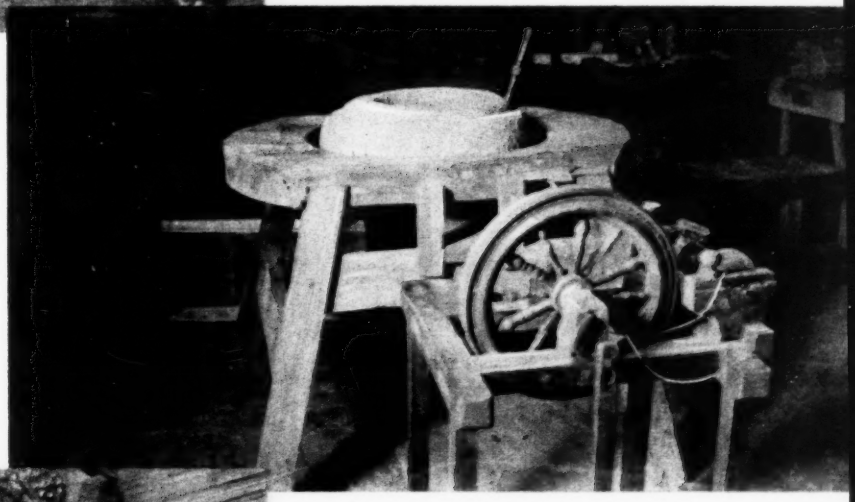
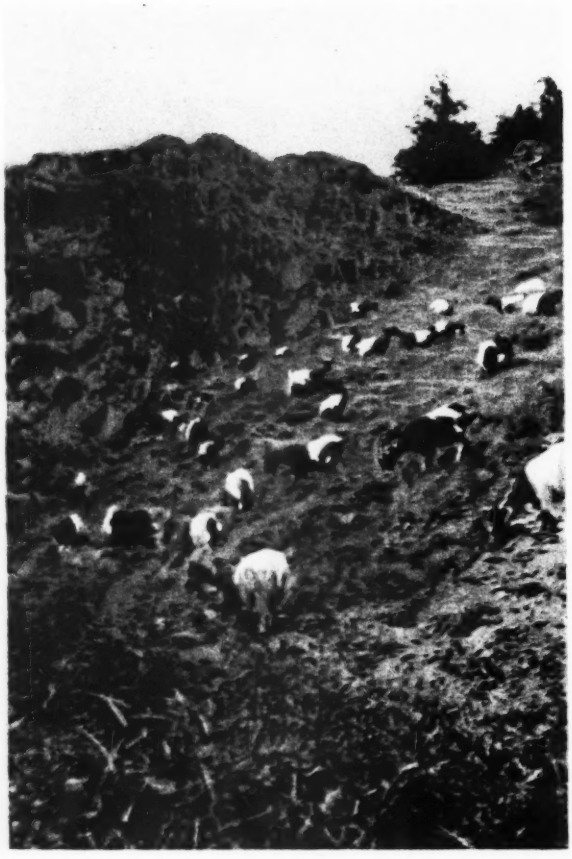


Fig. 3

Fig. 3—A primitive hand mill for home use. Larger types are run by water power.

Fig. 4—Community bake oven.

Fig. 5—View from Visperterminen.



Figs. 6 and 7—The route of the minerals and grain activators from the soil to bread in the high Alps.
Fig. 6—The goats feeding; Fig. 7—Harvesting the rye.

Fig. 8—The grist mill at Visperterminen for producing entire rye flour and meal

is evidence enough to answer the question whether cereals should be avoided because they produce acids in the system which if formed will be the cause of tooth decay and many other ills including the acidity of the blood or saliva. Surely the ultimate control will be found in Nature's laboratory where man has not yet been able to meddle sufficiently with Nature's nutritional program to blight humanity with abnormal and synthetic nutrition. When one has watched for days the gamboling child-life in those high alpine preserves of superior manhood and when one has contrasted them with the pinched and sallow and even deformed faces and distorted bodies that are produced by our modern civilization and its menus, and when one has contrasted the unsurpassed beauty of the faces of these children developed on Nature's primitive foods with the varied assortment of civilization's children with defective facial development, he finds himself filled with an earnest desire to see that this betterment is made available for modern civilization. It only requires a few hours journey from one of these human preserves of Nature to reach the highways of the ever-expanding industrial world to see the tragedy that can be wrought in these same people in an incredibly short time.

Over and over we had the experience of examining a young man or young woman and finding that at some period of his life caries had been rampant and had suddenly ceased, but during the stress many teeth had been lost. When we would ask such people if they had gone out of the mountain and at what age, they would generally say at 18 or 20 years of age they went down to this or that city and stayed a year or two. They stated they had never had a decayed tooth before they went or since they returned but had lost some teeth in the short period away from home.

At this point of our studies Doctor Roos found it necessary to return to his family but Doctor Gysi accompanied us to the Anniviers valley which is also on the south side of the Rhone. The river of the valley, the Navizenze, drains from the high Swiss and Italian borders north to the Rhone River. Here again we had the remarkable experience of finding communities near to each other, one with high immunity to tooth decay and another with rampant tooth decay.

The village of Ayer lies in a beautiful valley well up toward the glaciers. It is still largely primitive although there has recently developed a government road which like many of the new arteries has made it possible to dispatch military protection when and if necessary to any community. In this beautiful hamlet until recently isolated we found a high immunity to dental caries in which only 2.3 of each hundred children's teeth examined were found ever to have been attacked by tooth decay. Here again the people were living on rye and dairy products. We wonder if history will repeat itself in the next few years and that there too this enviable immunity will be lost with the advent of the highway. It usually does not take long after tunnels and roads are built to allow automobiles or even wagons to enter with modern foods and for these foods to do their destructive work. This is tragically demonstrated in this valley since a roadway was extended as far as Vissoie several years ago, and in this village modern foods have for some time been available. One could probably walk the distance from Ayer to Vissoie in an hour. The number of teeth found to be attacked with caries for each one hundred children's teeth examined at Vissoie was 20.2 as compared with 2.3 at Ayer. We had there a splendid opportunity to study the changes that had occurred in the nutritional program. With the coming of means for transportation and new markets there had been shipped in modern white flour, equipment for a bakery to make white flour goods, highly sweetened fruit, such as jams, marmalades, jellies, sugar and syrups —all to be traded for the locally produced high vitamin dairy products and high mineral cheese and rye, and with the exchange there would be enough money as premium to permit buying machine made clothing and various novelties that will soon be translated into necessities.

Each valley or village has its own special feast days on which athletic contests are the principal order of events. In the Loetschental valley, the report of the study of which appeared in the March issue of THE DENTAL DIGEST, the feasting through the past has been largely on dairy products. The athletes were provided with large bowls of cream as constituting one of the most popular and healthful beverages, and special cheese was always available. Practically no wine was used because no grapes would grow in that valley and for centuries their isolation prevented them from having access to much material that would provide wine. In the Visperterminen community, however, the special vineyards owned by these people on the lower level of the mountain side provided grape juice in various forms of fermentation, and for them their feasts in the past have been celebrated by the use of wines of rare vintage as well as with cream and other dairy products. Their cream products took the place of our modern ice cream. It was a matter of deep interest to have the President of Visperterminen show us the tankards that had been in use in that community for nine or ten centuries. The care of these was one of the many responsibilities of the chief executive of the hamlet.

We are deeply interested in the story the cemeteries can tell. It is reported that practically all skulls that are exhumed in the Rhone valley, and indeed practically throughout all of Switzerland where graves have existed for more than a hundred years, show relatively perfect teeth; whereas all burials in those communities of recent date were of people with teeth that had been riddled with caries or had been lost because of caries. It is

of interest that each church generally has associated with it a cemetery in which the graves are kept decorated, often with beautiful designs of fresh and artificial flowers. Members of succeeding generations of families are said to be buried one above the other to a depth of many feet. Then after a sufficient number of generations have been so honored their bodies are exhumed to make a place for present and coming generations. These skeletons are usually preserved with honor and deference. The bones are stacked in basements of certain buildings of the church edifice with the skulls facing outward. These often constitute a solid wall of considerable extent. In Naters there is such a group said to contain 20,000 skeletons and skulls. These were studied with great interest as was also a smaller collection in connection with the cathedral at Visp. While many of the single straight rooted teeth had been lost in the handling many of the teeth were present. It was a matter of great interest and importance to find that only a small percentage of teeth had had caries. Teeth that had been attacked with deep caries would have developed apical abscess and consequent destruction of the alveolar process. Evidence of this bone change would be readily visible if the teeth were lost from their sockets during the handling of the dry skeleton. These sockets still had their lamina dura continuous, indicating that the teeth had been vital at death.

It must be kept in mind that the purpose of these studies is to determine the cause of these changes in physical well-being of the people living in these different communities so closely associated. An important part of this consideration has to do with the food that is eaten. We can with safety assume that the present diet of these isolated groups is in general similar to, if not identical with, that of the entire district a relatively few decades ago. In the fifth of this series we will study the chemical and activator content of the primitive diets together with the chemical and activator content of the foods of nearby modernized communities in order that we may ascertain the fundamental changes that occurred in their nutrition.

(End of Second Installment)

COMING:

III. Field Studies in Modernized St. Moritz and Herisau, Switzerland.

IV. Field Studies in Primitive and in Modern Outer Hebrides, Scotland.

V. Practical Procedures for the Nutritional Control of Dental Caries.

Dental Research Laboratories
8926 Euclid Avenue.

PLASTER KNIFE

Leon C. Patterson, D.D.S., of Derby, New York, suggests the use of the following type of plaster knife:

An ordinary paring knife of good quality is selected. The knife should be strong and one on which the forefinger can easily remain on the handle while carving to avoid abrasions of the finger which are so common when a long-bladed knife is used.

The blade is cut away by grinding so as to leave only about one inch of the steel, with the cutting edge straight in line with the handle. The back or upper portion of the blade is rounded, in the form of a crescent, from the cutting edge to the junction of the back of the handle and the back of the blade. This is done by grinding.

Doctor Patterson finds that this type of knife gives an excellent point for trimming models.

AGRANULOCYTOSIS

SAMUEL SUSSMAN, D.D.S.
Brooklyn, New York

AGRANULOCYTIC angina is a condition marked by (1) destructive ulcerative lesions of the throat and mouth; (2) a leukopenia (reduction in the number of leukocytes); (3) marked reduction of granular cells in the blood and bone marrow, and (4) often icterus (jaundice). The disease affects principally middle-aged women and is usually fatal. It is also called agranulocytosis and malignant leukopenia.

The term agranulocytic angina, first suggested by Schultz, has been shown to be inadequate since many cases occur in which sore throat (angina) is absent; therefore, agranulocytosis might be the best term to characterize this disease.

Dental Significance

The dentist may be called on to make a diagnosis and to suggest treatment in these rare cases of agranulocytosis. Because of the tendency of the ulcerative patches characteristic of this disease to appear in the mouth and its possible confusion with Vincent's angina, it is necessary to be alert in order to recognize its clinical picture, and to advise immediate consultation. It is not known whether the ulcers represent the primary focus through which the microorganisms invade the body or whether they are merely the product of lowered resistance. The disease is not contagious.

History and Characteristics of the Disease

This disease was first reported by Schultz of Germany in 1922. Little information may be obtained about it in the standard textbooks. Osler has a few lines, but there is nothing in any of the books on oral surgery and diseases of the mouth. Lately there have been many cases reported by American and German observers.[1] Many regard agranulocytosis as a disease entity, but others maintain that it is simply a leukopenic reaction to an overwhelming infection. In view of the noncharacteristic bacteriologic and pathologic observations and peculiar blood counts, the latter view seems to be the logical one. The condition is common to both sexes with about 70 per cent occurring in women, according to most observers. They may occur and have been reported in all ages but the average age is 40. In the majority of cases there is a rapid onset generally after a period of good health. There is usually a continued high temperature, from 102 to 104 F., and prostration is common. Other prominent symptoms are sore throat, malaise, chills, and dysphagia. Necrotic or ulcerative processes have been observed almost constantly in various parts of the oral cavity and not infrequently lower in the gastro-intestinal tract, in the cervix and vagina. Occasionally the spleen and liver are enlarged. In about 50 per cent of the cases jaundice develops. The heart and lungs are normal in the beginning, but death is often preceded by terminal pneumonia.

The Blood Picture

The pathognomonic symptom of this disease is its striking blood picture. Leukopenia at the onset is the rule, the total leukocytes being reduced to 1200 or less per cubic millimeter. The normal average is 8000 per cubic millimeter. The polymorphonuclear leukocytes either are entirely absent or constitute less than 6 per cent of the white cells; the normal average is 64 per cent. The lymphocytes are relatively increased, sometimes up to 100 per cent, the normal average being 28 per cent.

An important feature revealed on examination of the blood is the maintenance of the normal red count and hemoglobin percentage (5000 per cubic millimeter). A few patients develop a mild secondary anemia late in the course of the disease. The platelet count and the bleeding and coagulation times are normal. Blood cultures are generally sterile, and in the few cases of positive cultures (10 per cent) there is no uniformity of microorganisms. The same uncertain and misleading bacteriologic picture is presented in the mouth. Among the many organisms found are the Vincent spirochetes, the fusiform bacilli, and various types of streptococci.

In its early stages agranulocytosis is easily confused with diphtheria, Vincent's angina, or so-called septic or streptococcic sore throat.

Treatment

Especially at the beginning agranulocytosis is largely symptomatic because the etiology is so obscure. Local treatment consists of reducing the inflammation of the gums and throat by frequent use of a mouth wash and gargle. General treatment is also nonspecific. It consists of the usual building-up treatment, frequent blood transfusions, and intravenous administration of arsenic compounds in the form of neoarsphenamine. Lately, stimulating doses of the roentgen rays to the long bones have been tried in an attempt to stimulate the bone marrow. Omnadin and arsphenamine are also used.

In view of the fact that arsphenamine preparations have been advocated as a treatment, it is necessary to take into consideration the fact that in antisyphilitic treatment with arsphenamine preparations complications have occurred which have resulted in agranulocytosis. Aubertin and Levy[2] obtained twenty-eight such cases from a review of the literature, fifteen of which were in women and thirteen in men. The various types of the disease could be demonstrated clearly. In all cases the onset was characterized by symptoms of intolerance to the drugs, although some authors held an infective bacterial agent responsible in the etiology of the disease. Aubertin and Levy point out the toxicity of some of the arsphenamine preparations. Furthermore, there appears to be an individual predisposition toward such manifestations.

Damashek and Ingall[3] report nine cases from November, 1928, to April, 1930, one in which arsphenamine was an etiologic factor. Two of the nine

[1] Blanton, W. B.: Agranulocytosis with Recovery, J.A.M.A., **92**:2099 (June 22, 1929).
Horn, H.: Laryngoscope, May, 1930.
Bromberg, L. and Murphy, P.: Agranulocytic Angina following Prophylactic Typhoid Vaccination, J.A.M.A., **92**:1266 (April 13, 1929).
Dwyer, H. L. and Helwig, F. C.: Agranulocytic Angina, Am. J. Dis. Child., **35**:1041 (June, 1928).
Franken, S. W. A. and Hensel, O.: Agranulocytic Angina, Dental Cosmos, **71**:1056 (November, 1929).

[2] Aubertin and Levy: Ann. de Med., February, 1930.

[3] Damashek and Ingall: Am. J. Med. **181**, 1930.

patients recovered. It is their belief that recoveries if they occur are spontaneous. Recoveries are to be expected not in those fulminating cases with a typical angina picture and drop in the leukocyte count to 1000 per cubic millimeter but rather in those cases which are more prolonged and milder.

Report of Case

Mrs. B., aged 42, white, appeared June 25, 1931, for treatment of the gums which were painful and bleeding more or less profusely. She had just been successfully treated by a gynecologist for pains in the vaginal region which later proved to be just another symptom as was this gum condition. Potassium chlorate as a mouth wash was prescribed by a physician but without success. The patient until recently was always in good health and of hygienic habits. Because of economic reverses and the hardship of teaching to which she was unaccustomed the patient's resistance was lowered.

Continual pain and difficulty in eating and swallowing were present. The gums were highly inflamed with ulcerative tendencies. The condition at first appeared to be a severe Vincent's infection. The patient was put under rigid home treatment, sodium perborate every fifteen minutes as a mouth wash being prescribed. Office treatment (three treatments the first day) consisted of topical application of arsphenamine with dextrose. The patient reported that she was more comfortable the following day. The treatments were repeated but at the end of the second day the patient experienced more discomfort, lack of appetite, and pains in the legs and side of the neck. A cathartic was ordered, a nutritional diet instituted, and local treatment was changed to a milder form. Sodium bicarbonate as a mouth wash and acriviolet topically applied soothed the condition somewhat.

What seemed to be a typical if exaggerated form of Vincent's infection now changed to a distinct ulcer formation on the palate and along the gingival margins, both buccally and lingually, with a tendency to coalescing and forming a continuous grayish white band, which could be easily detached from the necks of the teeth, a raw, bleeding surface being left. This band might be confused with a diphtheritic membrane.

The roentgenograms showed poor root canal work, poor approximal contacts with absorption of the alveolar process as a consequence but not in proportion to the severity of the condition.

A Wassermann test, examination of the blood, and urinalysis were advised immediately but because of economic conditions, or perhaps because the seriousness of the condition was not appreciated, these were not obtained until the first of July. The patient was becoming weaker and more drowsy; a swelling appeared on the right side of the upper maxilla. Table 1 gives the laboratory report of the examination of the blood.

On recognition of the peculiar blood picture, the patient was immediately sent to the hospital where she was admitted on July 2, 1931.

History—The past history was good and irrelevant. The present illness dated to about June 20, 1931, at which time the patient noted pain in the lower part of the abdomen, lassitude, and weakness. The family physician was called and the presence of an ovarian cyst was suggested.

TABLE 1

Analysis of the Blood

Composition	*Number Per Cubic Centimeter*	*Normal Average Per Cubic Centimeter*	*Laboratory Diagnosis*
Erythrocytes, Normal Size, Shape, and Staining.	4,320,000	5,000,000	Marked Neutrophil Leukopenia
Occasional Normoblast			Slight Anemia of Primary type
Hemoglobin	80 per cent		
Plaques	200,000	200,000	
Leukocytes	2,600	8,000	
Differential Count:	Percentage	Normal Average Percentage	
Polymorphonuclear Neutrophils	9	60.0	
Polymorphonuclear Eosinophils	0	3.7	
Polymorphonuclear Basophils	0	0.3	
Lymphocytes, small	76	25.0	
Lymphocytes, large	8	3.0	
Mononuclear, large	7	8.0	
Pathologic Leukocytes	0		

TABLE 2

Response of White Blood Cells to Adenine Therapy

Date 1931	*Time*	*White Blood Cells Per Cubic Centimeter*	*Granular Cells*	*Dosage*
July 1	12:00 P.M.	600	0	Adenine ½ Gram
July 2	3:00 A.M.	1,150	3	" " "
	8:00 P.M.	2,250	6	" " "
July 3	10:30 A.M.	1,400	2	" " "
	4:00 P.M.	1,850	1	" " "
	8:50 P.M.	1,800	2	" " "
July 4	8:00 A.M.	2,100	3	" " "
	10:00 P.M.	1,450	2	" " "
July 5	10:00 A.M.	1,050	0	" " "
	8:00 P.M.	550	0	" " "
July 6	8:00 A.M.	200	0	" " "
	9:00 P.M.	200	0	" " "
July 7	8:00 P.M.	120	0	" " "
July 8	9:00 A.M.	40	0	" " "
July 9	9:00 A.M.	20	0	" " "

Within the next few days the patient's mouth became sore and with it the temperature became elevated. The mouth was examined and was found to be in a condition of infection and necrosis suggestive of Vincent's angina.

Physical Examination—On admission the physical examination showed the patient to be well nourished but acutely ill. The temperature was 104 F.; the pulse rate, 130, and respiration, 20. There was a moderate degree of swelling of the right side of the face, and the gum margins were three times the normal size and covered with a heavy adherent gray exudate. Some of the submaxillary glands were enlarged, especially on the left side. The left lung showed signs of a condition interpreted as pneumonia of the left base. The blood pressure was 108 systolic and 76 diastolic. Urinalysis and chemical examination of the blood showed the composition of the urine and blood to be within normal limits. The Wassermann reaction was negative with the amount of hemolysis approximately 100 per cent. The blood count revealed a marked leukopenia; the white blood cell count was 500 with an absence of polymorphonuclear cells. The response of the white blood cells to adenine therapy is given in Table 2. A clinical opinion was made of agranulocytosis.

Clinical Course—There was a continuous rise in temperature between 103 and

Granulopenia and Agranulocytic Angina—*Harkins*

I. TERMINOLOGY

A. Agranulocytosis: Proposed by Schultz in 1922.
Adopted lately because of brevity.
Inaccurate etymologically: "The name 'agranulocyte' was originally chosen for 'neutrophiles' without granulations of leucemias. By 'agranulocytosis' is meant an increase in these atypical neutrophiles, which was not intended."—Schilling

B. Agranulocytic Angina: Proposed by Friedmann in 1923.
Too long.

C. Malignant Neutropenia: Proposed by Schilling.
Inadequate because not only the neutrophils but all the granulocytes are decreased.

D. Granulocytopenia or Granulopenia: No objections.

II. CLASSIFICATION

A. Primary granulopenia—agranulocytic angina
1. Acute
2. Chronic or recurrent (not rare)

B. Secondary granulopenia which is due to
1. Chemical poisons
2. Radiation
3. Sepsis
4. Blood Diseases—pernicious anemia, aleukemic leukemia, and aplastic anemia.
5. Infections—measles, mumps, influenza, typhoid, and malaria.

III. REPORT OF CASES

A. Thirty-six cases of agranulocytosis collected from the literature.

B. Of seventeen patients treated in the past seven years at the University of Chicago Hospitals, two died after an attack following the extraction of a tooth.

C. Soreness of the mouth or gums is a frequent symptom. Severe gingivitis and ulcerated gums were present in two cases cited and a white patch on the gums was also present in one of the cases cited.

IV. ETIOLOGY

A. Precipitating factors include dental extractions, tonsillectomy, and other trauma to the mucous membranes.

B. Oral lesions and sepsis are secondary to the agranulocytosis.

C. Primary agranulocytosis may be due to some endocrine factor, such as allergy, endocrine disturbance, or congenital deficiency of the bone marrow.

D. A causative factor may be an exogenic agent, acting either on a normal person or on a person with a special susceptibility.

B. Influenzae and chemical poisons are to be considered. The causative agent acts chiefly on the bone marrow.

V. TREATMENT

A. Good oral antisepsis, gargles, and other efforts to treat the local angina may delay the entrance of the malignant organisms from the mouth and pharynx. Attempts to raise the white cell count to normal will not save the patient's life if sepsis is too advanced.

B. All treatment should be directed primarily toward raising the granulocyte count as soon as possible.

C. Blood transfusion and roentgen rays are of no proved value. Chemical agents intended to stimulate the bone marrow are in general ineffective.

—Harkins, Henry: Granulopenia and Agranulocytic Angina, J. A. M. A. 99:1132 (October 1) 1932.

104.4 F. The pulse rate varied between 90 and 180, and respiration between 20 and 50. An attempt was made to stimulate the blood forming organs and to produce an increase in white cells. This was done by administering adenine sulphate, one-half gram every twelve hours. The patient also received dextrose intravenously, three blood transfusions, and saline clysis,* which Doctor E. R. Marzullo gave subcutaneously, but there was no response to treatment. The patient died on July 9, 1931, and it was believed that, clinically, death was due to an overwhelming toxemia.

At postmortem examination the following anatomic observations were noted: (1) lobular pneumonia of the left lower lobe; (2) stomatitis of the diphtheritic type, and (3) hypoplasia of the bone marrow.

Conclusion

Agranulocytic angina, better termed agranulocytosis, has hardly begun to be recognized in this country although it has become the subject of much writing elsewhere. There are reasons for believing the disease is by no means extremely rare; and if blood counts are more often performed in cases of extensive oral lesions of the type described the condition will certainly be recognized more frequently.

Since the disease is generally accompanied by mouth lesions and Vincent's organisms may or may not be present, any acute case of Vincent's infection that does not respond to ordinary treatment after two or three days should be referred to those capable of making a differential blood count with the idea that it may be agranulocytosis.

*According to Stedman, "Clysis is the washing out of stagnant or waste materials in any cavity or in the blood by means of injections of fluids."

175 Eastern Parkway.

ANNOUNCEMENT

of change of address of the Editorial Office of

THE DENTAL DIGEST

The Editorial Office has moved into new quarters. The new address is 708 Church Street, Evanston, Illinois. All manuscripts and correspondence regarding editorial matters should be sent to this address.

COMPLETE FULL DENTURE TECHNIQUE

(FIRST OF EIGHT INSTALLMENTS: THE PREEXTRACTION VISIT)

C. J. STANSBERY, D.D.S.
Los Angeles

THIS article on the construction of full dentures is written for the special benefit of general practitioners. The technique answers the need of the general practitioner to improve his method of making full dentures and is sufficiently simple for universal use. Its adoption by the general practitioner will place his denture service on a plane that will compare favorably with any other branch of his dental service. The dentist who can least afford to have make-overs, come-backs, and post-delivery appointments is one whose fees are such that work done beyond the initial finish of the case entirely absorbs the profit and leaves the operation a financial loss; what is worse, such a procedure may lose the confidence of the patient and his potential value as a practice builder. I have never practiced in a small town nor rural community, but I am more than willing to believe the observations of those who have that the successful construction of artificial dentures is the dentist's greatest practice builder.

The method to be described is a simple, logical technique based on and interpreting research of recent date. It is based on facts of general knowledge to every dentist and can therefore be more readily understood than a technique based on entirely new premises. Research men do a vast amount of work, the only practical value of which is to lay the foundation for a usable technique. This article is encumbered with no more theory than is necessary to make the technique clear and understandable.

It is not necessary in this technique to determine condylar inclinations, record lateral shift, determine axes, either opening or lateral, nor set rotational centers. It is not necessary to use the face-bow nor other positioning devices. All of these dimensions and positions are automatically recorded, in proportion to their relative importance, by the method of check-bite used. The technique does not require manual dexterity beyond that possessed by the average operator; it consumes less time than the average anatomic methods, and eliminates the operation of chewing-in and spot-grinding finished dentures. While ease and time-saving are stressed both are of secondary importance; the excellence of the finished dentures is of paramount consideration.

Some may doubt the possibility of achieving proper results with the omission of condylar measurements and the exclusion of the face-bow. I do not mean to say that the condyle path inclinations, lateral shift, and rotational centers have no value. They are important, but I do not attempt to measure their elusive and obscure movements and reproduce them in articulator mechanism. I measure only the relative positions of the alveolar ridges, a measurement that can be done with great accuracy and ease. After all, the relative positional changes of the ridges are the resultant of muscles, condyles, and axes. If the resultant is measured with precision, one automatically secures the measurements of them all.

The technique is promised as easily understandable and to fulfill this promise I must omit the face-bow and its technique. The only function of the face-bow is to establish a horizontal axis around which the mandible opens vertically, separating the teeth from contact and thereby establishing *no functioning* relation, no occlusion, nor balance. One should not confuse the so-called opening component of lateral movement with the pure opening on the condyle chord. I for one do not understand the necessity for establishing an axis not concerned in any functional articulation. The instrument used in this technique has no provision for the placement of the face-bow.

Preextraction Visit: Technique

1. *Recording Shade of Natural Teeth*—If the dentist has the opportunity of seeing the patient before extraction, it will greatly aid him if he will make records of certain natural characteristics to be used in the construction of the dentures. First a notation should be made of the shade of the natural teeth of the patient on the patient's record card or on his facial templet which will be described later.

Often, of course, the dentist's first contact with the patient is after the patient has become edentulous. For such patients this first installment of the full denture technique does not apply.

Much has been written on the selection of form and color and it is, therefore, beyond the scope of this series to discuss that extensive subject. If the dentist has not established a basis for color selection it is wise to follow the color and form of the natural teeth when possible.

2. *Record of Natural Teeth Mounted in Plaster*—A. A roll of softened modeling compound about the size of a finger is placed around the entire arch. With the fingers this compound is made to conform to the labial and buccal surfaces of the teeth while the patient helps with his tongue to make the compound conform.

B. The compound is chilled, removed, and laid to one side.

C. After the extraction the extracted teeth are placed in their respective positions in this modeling compound bite-roll and plaster is poured to engage their roots.

D. The plaster is extended distally to form an index of the upper teeth to the lower to maintain their relative positions. This forms a plaster articulator (Fig. 1).

It should be explained to the patient that this method is used so that individualities may be imitated in the artificial dentures, such as rotated central incisors, overlapping laterals, or prominent cuspids. The size and form of the natural teeth will also aid the dentist but the extracted teeth should not be depended on for shade. In gross irregularities if only one third or one fourth of the irregularity is reproduced a pleasing natural appearance will be obtained.

3. *Record of Normal Facial Outline*—At the first appointment also a

Fig. 1—Study casts showing size, form, and peculiarities of arrangement of natural teeth.

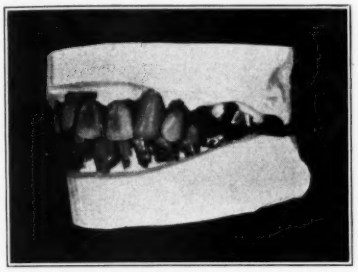


Fig. 2—Note evident closure of the bite shown by relative position of upper cuspid and lower bicuspid.

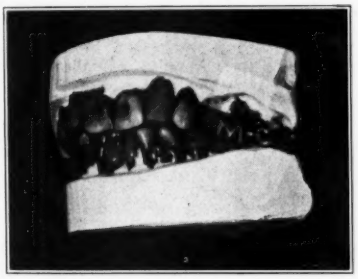


Fig. 3—Conditions in Fig. 2 have been corrected by block of modeling compound marked M-C.

record of the normal facial outline is made by constructing what is generally termed a facial templet. If a closure is evident, owing to the loss of many teeth, the natural opening can be better approximated at this time than if this measurement is left to be restored at a later time or in a step of the impression taking. To approximate this opening, occlusal blocks of modeling compound should be constructed on the remaining teeth to restore the natural facial dimension, and with these blocks in place the facial record is made (Figs. 2 and 3). If a closure is not evident, of course, these modeling compound blocks are not required.

Methods of Making Templet

1. *Wire*—One method of making the templet is by the use of soft lead wire. Fuse wire of 13 or 14 gauge serves this purpose excellently.

A. With a piece of this wire, 7 or 8 inches long, begin at the median line of the nose immediately between the eyes and by contouring the fingers and pliers follow accurately the profile along the median line of the nose, its columna, lips, and down to about an inch and a half under the chin.

B. After the contouring is done, lay the wire on a flat surface and gently pat to correct sidewise deflections and replace against the face for final fitting (Fig. 4).

C. Again the wire is laid on a flat surface and over it is placed a smooth white cardboard about the thickness of an ordinary blotter. The card placed over the wire is rubbed with the smooth handle of an instrument, and the outline of the contoured wire will appear on the opposite side of the card.

D. Carefully cut along this outline and preserve the negative of the facial outline.

E. This is held against the patient's face and here again slight corrections may be made though they are seldom necessary.

F. During this entire procedure the patient should be cautioned to keep teeth or modeling compound blocks in light centric contact and the lips as much at rest as possible (Fig. 5).

G. To this cut-out or templet the position of the mesio-incisal angle of the natural central is added as follows: On the flat side of a thin strip of metal, 1½ inches long and one-fourth inch wide at one end, and tapered to a point at the other, two short pins are soldered, one pin near the middle of the strip and one near the blunt end. These pins should be sharp so that they may easily be forced through the cardboard. Again the templet is placed on the face, and the patient exposes the upper incisors. While the point of this metal strip is held at the mesio-incisal angle of the central the card is punctured with the two pointed pins (Fig. 6).

Fig. 6—Strip of metal used to locate mesio-incisal angle of upper central. Note perforation made by pins in templet in Fig. 5.

The advantages of the wire method are: (1) It can be finished and tried on at the same sitting; (2) it incurs no expense, and (3) no special equipment is necessary. The metal strip mentioned can be made in a few minutes and used in all succeeding cases. The disadvantage is that in some patients it is difficult to control muscle tensions which materially alter the profile, especially around the lips and chin, while the wire is being fitted. Psychologically, the patient is not so impressed with the effort being made for exactness and preservation of appearance as in the photographic procedure.

2. *Photography*—Another templet method is the photographic one. With a camera that will take actual size pictures two profile views are taken of the patient, one with the teeth just touching in centric occlusion, as described previously, and the second one with the mouth open and the upper lip raised to show in the profile as much of the central incisors as possible. When the negatives are printed

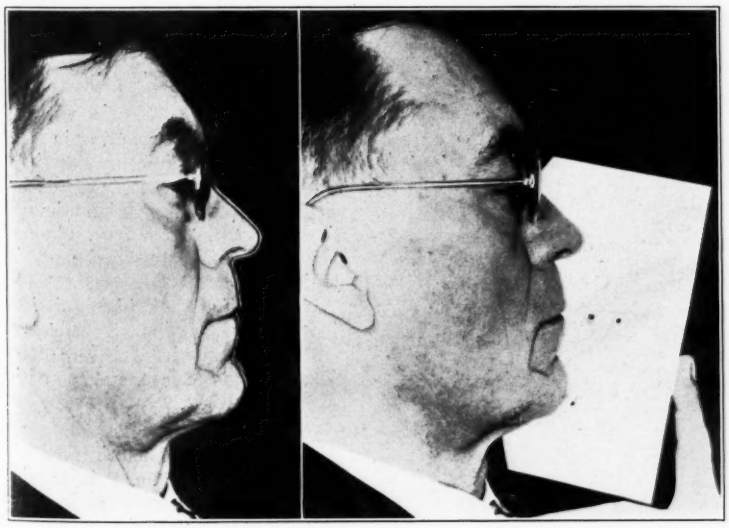


Fig. 4 Fig. 5

Fig. 4—Flexible wire adapted to patient's profile.
Fig. 5—Verification of facial templet before extraction.

Fig. 7—Pictures from which templets are made, one for profile and the other for positioning the central teeth.

Fig. 8—Miniature inset shows a print from a small film. Enlargement is from the same film to show 4 inches between notches, which was the actual distance between them.

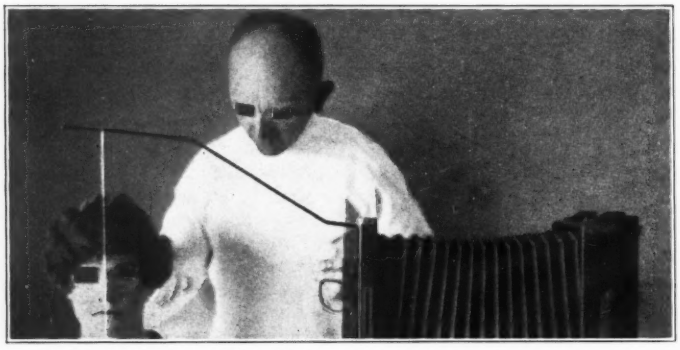


Fig. 9—Suspended cord from the arm projecting forward from the camera is exactly twice the focal length of the lens from the lens. The film is the same distance; a condition that produces actual size pictures.

Fig. 10—A method using a wick of twisted cotton twine saturated with quick-setting plaster and then reenforced to use as in the lower picture. Vaseline is applied to the face before the plaster is applied.

the facial portion of the picture is cut away and the blank part becomes the templet (Fig. 7).

The equipment necessary in this method is a camera with at least a 5 by 7 inch plate and bellows extension of double the focal length of the lens. The patient must be posed at this double focal distance from the lens to make the resulting picture of accurate actual dimension (Fig. 9).

3. *Photography and Ruler*—Another equally good way to make a templet is to take these two pictures with any type of camera while the patient is holding a ruler, as in Fig. 8. In printing the miniature may be enlarged so that the picture of the ruler will be correct in dimension; the facial dimension will also be true. The facial portion is cut out as in the previous method.

If convenient it is highly desirable that in any one of these methods the templet be completed before extraction, tried to the face, and the patient asked to commit himself on the accuracy of the fit.

The advantage of this method is that no special camera is required. Nearly all outing cameras have portrait attachments which add to the accuracy of this method. The advantage of both this method and the previous one is that the record is made

without touching the face, thereby avoiding a muscle tension that many patients find hard to control. There are a number of other methods to record facial profiles and the mere fact that so many ways have been devised should be evidence of the value and necessity of this important step. I claim no originality for any of these procedures other than the addition of the relative position of the natural central incisors (Fig. 10).

Fig. 11—The use of templet: A fitting should be made prior to extraction, at the time of determining the proper vertical opening, at the try-in of the waxed up dentures, and after finishing the case.

Comment

The preextraction visit is the most important psychologically of any of the appointments, for at this time the dentist has the opportunity to quiet the patient's fear that the wearing of artificial dentures will change his appearance. Few of us realize how limited is the patient's knowledge of dentistry and dental terminology, and often our best efforts toward an explanation fall on uncomprehending ears. In the methods described argument is made more convincing by visual procedure, the value of which all can understand. The use of one of these three procedures will eliminate many errors that the dentist might make in his efforts to restore facial contours with only his past visual impressions as a guide. Many patients become so accustomed to their appearance after extraction, the sunken lips and closed bite, that the sudden return to normal looks strange to them.

There is not a dentist who has not had such a patient say, "Doctor, my lips never stuck out like that!" (Fig. 11).

The next installment will deal with the taking of the upper impression. A method will be described which I have used with gratifying and consistent success for eight years.

(End of First Installment)

604 Medico-Dental Building.

ABOUT OUR CONTRIBUTORS

Herbert Irving Goodale of 626 Elm Street, Buffalo, New York, is a physicist, and in collaboration with Mr. Reinhard has written other articles on roentgenography as a result of their investigations.

Melvin Charles Reinhard of 113 High Street, Buffalo, New York, received his B.S. in 1922 and M.A. in 1926, both from the University of Buffalo. Mr. Reinhard is a physicist who has written extensively for technical and scientific journals both alone and in collaboration with other scientists. The article appearing in this issue of which Mr. Reinhard is co-author represents his thirtieth published article.

Harold Arthur Solomon's professional biography appeared in the July, 1932, number of The Dental Digest.

The biographies of M. Hillel Feldman, D.D.S., and Weston A. Price, D.D.S., M.S., F.A.C.D., appeared in previous issues of The Dental Digest.

Claud J. Stansbery, D.D.S. (University of California, 1905) was one of the few men who studied with Doctor Gysi in 1913 when he came from Switzerland to conduct courses in full denture prosthesis. In 1918 Doctor Stansbery served as President of the N. S. D. P. and has been one of the active members since its organization. For years Doctor Stansbery has taught courses in denture construction. He is a member of the A. D. A., Los Angeles District Dental Society, and the Southern California Dental Society, and a life member of the Seattle District and Washington State Dental Societies. Doctor Stansbery formerly practiced in Seattle but has recently moved to Los Angeles, where his practice is devoted to full denture prosthesis.

Samuel Sussman has his D.D.S. from the New York University College of Dentistry (1914) where for five years he taught in the operative department and for three years has been teaching in the department of oral surgery. Doctor Sussman is a member of the Second District Dental Society; the A. D. A.; Omicron Kappa Upsilon, and Sigma Epsilon Delta.

Fred Gailer White has his D.D.S. from the George Washington University (1911), School of Dentistry. He is the author of Twenty-Three Minutes for Inlays, Chicago, The Pontiac Press, 1928. Doctor White is a member of the A.D.A., Arkansas Dental Association, Northwest District Dental Society, and Washington University Dental Alumni. He has done research work on investment compounds and casting techniques.

The Editor's Page

WILLIAM J. GIES, Ph.D., Sc.D., LL.D., a loyal friend and ardent worker in the best interests of dentistry, has written a monograph[1] on THE STATUS OF DENTISTRY. It is a clear and devastating argument against the "master-servant plan" of dental training and practice wherein the mental part of dental practice is undertaken by a few physicians and the manual part delegated to a large group of poorly-trained technicians. Doctor Gies' study is at the same time a vigorous answer to those who would destroy the separately organized profession of dentistry and make it a graduate specialty of medical practice. This article is, in all, an indictment of any person or any group that would "sell dentistry short."

Gies does not believe, nor does any serious thinker, that dentistry should develop along purely mechanical lines. Dentistry in its evolution should have "its roots in the same biological soil that nourishes medicine."[2] The dental organs and tissues are a part of the organic whole of the human body; they are not inert appendages devoid of body fluids and vital tissue. The newer concept of dental medicine and surgery emphasizes this intimacy. We no longer search exclusively in the biomechanism of the mouth to explain dental caries; no longer do we rely on local therapy alone to treat some classes of caries and periodontal disease. Because in any disease of a *part* there is some involvement of the *whole*, we appreciate the significance of dental disease in its relationship to general health. No sane person would propose that we preoccupy ourselves with pure tinkering and ignore the biologic foundations upon which we build.

We should, Gies says, be independent from medicine but interdependent with medicine; we should coordinate with but not be subordinated to medicine[3]:

> Dentistry to attain the full *health-service equivalence* [italics ours] of an oral specialty of medical practice, must understand and exemplify the related scientific principles of the best medical practice. To this end, dentistry must also observe the corresponding requirements of "clinical medicine," which *include* recognition of the known conditions or disorders that, in the interest of the patient, may affect a dentist's procedure or be influenced by them. The most important general purpose in medical practice should be to *keep people healthy.*

As an example of what it means to the dentist to keep the medical point of view, or better still the biologic, we may refer to an article by Rhoades and Dick[4] on the subject of the roentgenographically negative pulpless tooth. From the work of these investigators, says a recent editorial in a medical journal,[5] "it seems justifiable to regard all pulpless teeth as possible foci of infection whether they show apical changes in the roentgenogram or not. At least this position should be taken in the presence of systemic disease of a type usually associated with focal infection."

We may view this statement in three possible ways: First, we may accept it in toto, and put the findings into practice at once; that is, we may order all pulpless teeth removed. Second, we may reject it entirely and pour ridicule on the investigators and call them "radicals," "cranks," or "theorists." This, in spite of the fact that one of them (Dick) is internationally known for his work on streptococcic disease and scarlet fever. This method of close-minded rejection is emotional and not scientific. Third, we may neither accept nor reject the findings *for the present.* We may question the research method, ask for more data, demand more and a different kind of evidence, and then coordinate these bacteriologic data with clinical observations; that is, we may defer judgment until we have the substantiating evidence, the *total* information.

With regard to this and all other biologic problems within our field, we should be skeptical and critical, but not indifferent or uninterested.

Dentistry is a part of the science of medicine and must use the scientific approach to its problems. But also dentistry is a separately organized profession and not a specialty of medical practice. Herein is a distinction and a difference.

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[1]Gies, W. G.: The Status of Dentistry, J. Dent. Research **12**:945-990 (December) 1932.
[2]Final Report of the Commission on Medical Education, December, 1932, pp. 216-217.
[3]Footnote 1, section 12, page 970.

[4]Rhoads, P. S. and Dick, G. F.: Roentgenographically Negative Pulpless Teeth as Foci of Infection: Results of Quantitative Cultures, J. A. D. A. **19**:1884 (November) 1932.
[5]Editorial, J. A. M. A. **100**:974 (March 25) 1933.

SIMPLIFIED EXPANSION TECHNIQUE

F. G. WHITE, D.D.S.
Fort Smith, Arkansas

THERE have been many long and tedious methods advocated for the compensation of the shrinkage of the gold. It recently occurred to me that if a film of some material were painted over the ball of investment compound, after the wax pattern had been completely covered, and if that material could be carbonized at a low temperature, a space would be left between the inner and outer investments to allow the inner investment to expand enough to make up for the shrinkage of the gold. To this end experiments were made with the technique described here.

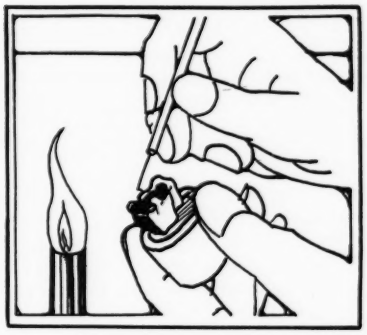

Fig. 1—Heating the cavo-surface angle of the wax pattern before withdrawal from tooth.

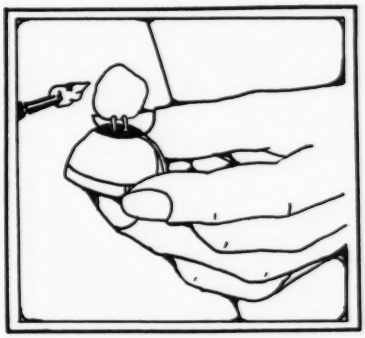

Fig. 4—Ball of investment around the pattern.

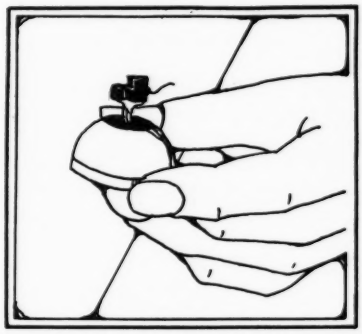

Fig. 2—A piece of dental floss one-fourth inch long attached to wax pattern.

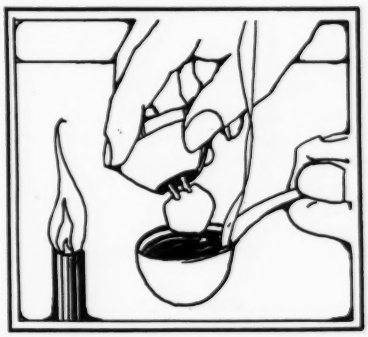

Fig. 5—Dipping the ball of investment into melted inlay wax.

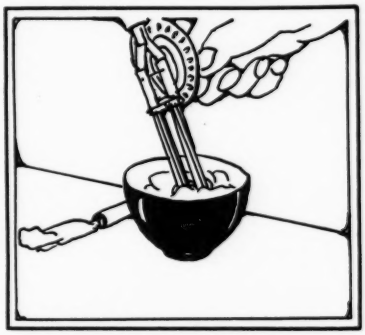

Fig. 3—Use of an egg beater in mixing the investment.

Fig. 6—Pouring the outer investment.

Technique

Wax Patterns—In making all wax patterns a red hot, right angle explorer point is traced around the cavo-surface angle of the pattern to a depth of 1 mm. This flows the wax against the cavity walls and also releases the tension of the molecules of wax. The tension is due to the fact that the wax is forced into position. This is an important step in the waxing technique (Fig. 1).

Casting—The following steps give a simple and practical direct method of casting to dimension based on scientific facts. The method shows that castings can be made to dimension.

The setting and thermal expansion of the investment (not wax expansion) is utilized to compensate for the contraction of the gold.

Any inlay wax that meets the American Dental Association specifications may be used.

1. The wax pattern is mounted on a sprue former. A piece of dental floss is attached to the wax pattern. This floss carbonizes, leaving a vent for the escape of carbon gases left in the mold chamber (Fig. 2).

2. The mix for the inner investment is made of 10 Gm. of investment and 3 cc. of water. Water of room temperature is used for the mix. The inner investment is spatulated by hand. (Kerr's Cristobalite Investment is described in this technique.)

3. The mix for the outer investment is made of 50 Gm. of investment and 16 cc. of water. The outer investment is first spatulated by hand, then with an ordinary rotary egg beater for fifteen seconds (Fig. 3). This is important to produce smooth castings and to obtain the maximum amount of expansion. A thin brass inlay ring is used.

4. A ball of investment is made around the wax pattern (Fig. 4), and the investment is allowed to set for fifteen minutes.

5. After the investment sets the ball of investment is dipped in hot inlay wax (Fig. 5). The amount of setting expansion is .38 per cent.

6. When the wax coating is dry an outer investment (Fig. 6) is poured.

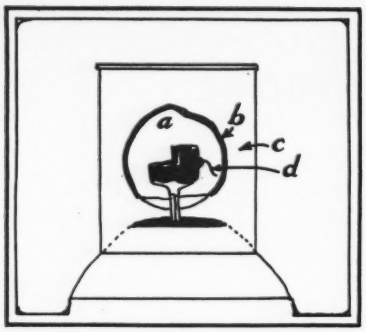

Fig. 7—Cross section showing completed investment. A, Ball of inner investment; B, coating of inlay wax around inner investment; C, outer investment; D, tape dental floss, one-fourth inch long.

A small tea strainer may be used to sift the investment into water.

7. The investment is allowed to set for twenty minutes.

618 First National Bank Building.

8. The time required for elimination is twenty-five minutes after the investing is done. The entire heating time is forty minutes: fifteen minutes at 500° F.; fifteen minutes at 900° F., and ten minutes at 1300° F.

The setting expansion is .38 per cent; the thermal expansion is .85 per cent, and the total expansion is 1.23 per cent. The contraction of gold is 1.25 per cent.

9. Casting is done at once on any standard casting machine. The gold should not be allowed to become too hot, and should never be carried to a white heat. The resultant casting will have a smooth, polished surface and will go to place with thumb pressure. It is important that the casting be made when a dull red can be seen through the sprue hole. Most high heat investments shrink rapidly if heated much more than 1300° F.

The investment compound used in this technique must be an expanding investment with a high silica content. (Cristobalite is recommended.)

The film of wax between the inner and outer investments carbonizes when subjected to heat, thus permitting the maximum amount of expansion of the mold chamber. The use of the wax eliminates all of the resistance of the outer investment.

It is suggested that a thermal controlled electric furnace, such as the Woodbury Jelenko type, be used in this technique.

It is important that the first or low heat should not be sufficiently high to boil the water from the investment. It should be considered a drying heat in which the moisture is eliminated slowly; to burn out too rapidly is likely to produce a rough casting.

GAGGING

Doctor Amos G. Stiker, Addison, New York, believes that the problem of gagging has usually been approached from the wrong angle and that it should be considered first from the standpoint of causes and secondly of treatment. Many years of clinical experience lead him to believe that gagging has three principal causes:

1. *Tickling of the throat by light or intermittent pressure.* This is what happens when the placing of an x-ray film causes gagging. To avoid this the film should be placed quickly, firmly, and accurately. It is better to press it to place so tightly that the film will even cause slight pain than to annoy the patient by playing with the film which encourages gagging.

2. *Allowing the patient to tickle his own throat by moving the soft palate.* This is what happens with an open mouth large tray plaster impression. The remedy is to make closed mouth impressions in well-fitting, made to order trays of some stiff base plate material. When the mouth is closed the patient will hold his tongue against the roof of his mouth to keep the plaster from going down his throat. At the same time, he will keep pressure against the soft palate which will reduce the movement of the soft palate and avoid tickling.

3. *Systemic conditions.* Hyperthyroidism and nervous conditions call for sedatives. For an overfull stomach the remedy is obvious. Hypochondria demands that the operator be something of a psychologist and use positive suggestion.

Doctor Stiker is of the opinion that if these principles are kept in mind, there will be almost no need for lozenges or novocaine.

UNION OF FRACTURED DENTINE

Report of Case

Clinton E. Hurdle, D.D.S., of Quincy, Illinois, reports the case of a man, aged 45, who fractured his arm, nose, and the maxillary right central incisor when he fell from a tree more than twenty-five years ago. The patient recalls that the tooth shown in the accompanying roentgenogram

was loose and sore for a time following the fall, but it now appears perfectly normal, even as to color, regularity, and firmness. The tooth responds normally to vitality tests.

Doctor Hurdle is of the opinion that this case disproves the theory that fractured dentine does not unite.

IN Cleveland's Euclid Avenue is an old red brick mansion. The neighborhood, one of former grandeur, is decadent. There are other houses in this street and in this neighborhood, but people no longer live in them. Business and industry have moved into this wide thoroughfare and taken over these old homes. Trucks and street cars rumble along; brakes squeak in the busy avenue; blatant and florid signs cry out from the austere faces of the old mansions: reminders of a gluttonous and jewel-crazed civilization. Crass commerce has seized this section of the city. The people who once lived here have fled to newer and fresher neighborhoods —or have gone.

It is a winter morning. From out of Canada, across Lake Erie, a chill wind sweeps in upon Ohio's sturdiest city. A taxi-cab stops before number 8926 in Euclid Avenue—before the red brick house. The symbol of commerce is not upon it. Briskly, up a long passage, two men move toward an entrance at the side. Through a window they see the equipment of a dental office: a chair unoccupied, a bracket table, the outlines of a dental engine. This is no ordinary dental office that they are coming to see; no ordinary dentist. Such a mission would not carry them out this chilly morning. These men are frank skeptics coming to visit the laboratories where a colossal piece of dental research is being carried out. They have come to talk to the man who is directing these important studies; to see and to hear at first-hand. A modest sign reads: "Weston A. Price, D.D.S., M.S."

We enter a large reception room. A gas fire sputters in a fireplace. Dog-eared and soiled magazines upon a table tell the story that this is a place to which many persons come in the course of a day. They sit a while, and in the way of dental patients turn nervously through the pages of the magazines. This is no laboratory of impersonal research. People come here. The findings of the laboratory are checked against clinical problems. This is a laboratory where the guinea-pig and the rat have their place, but only as auxiliary agents to the study of the problems of dental disease in man. Perhaps this is not what Alexander Pope meant when he wrote: "The proper study of mankind is man," but the epigram applies.

In the history of biologic discoveries, one fact always stands out in sharp relief: whoever has made an announcement a little different from the accepted beliefs of his period lays himself open to ridicule and abuse. Leeuwenhoek, who talked of the "little animals," and Pasteur, who said more about them, were scoffed at. Harvey, who dared suggest that the blood circulated through the body, was hooted down. Morton and Wells, who said that it was possible to administer certain gases and vapors by inhalation and so make persons unconscious of pain, were called humbugs. Price, who believes that through nutritional reinforcement dental caries can be largely prevented, has had and expects to have derision heaped upon him. But through it all he smiles and builds on his convictions. To those who are genuinely interested in learning about his work he gives unselfishly of his time and energy.

Price is no reformer, no crusader. He does not rant or engage in wild speculation. He has none of the hallmarks of the zealot or the faddist. He will quietly and with profound sincerity tell you the story of his work and his deductions. Whether you believe with him or not will make no great difference in Weston Price's life and actions. He will continue, as he has been doing for years, to carry on his studies in the spirit of pure science, at his own expense, with his twelve loyal co-workers who comprise his research staff.

If you should spend a day with this gracious and modest scientist, you will see a basement in an old mansion converted into a machine shop, and the home for the animals used in experimentation. Throughout the laboratories you will see ingenious machines and instruments that were made in this basement shop: centrifuges; a camera, to be fastened to the running board of an automobile, to determine the character of the sun's rays in different places; a giant apparatus in which the rays from a mercury quartz light are broken up by a prism for laboratory animals to be placed in the several bands of the spectrum for study.

On the first floor is the clinical dental department where Doctor Price and his two dentist-assistants carry out the clinical check on their laboratory and field discoveries. Incidentally, this department furnishes the revenue for the entire research project. This is a private enterprise without subsidies from philanthropic foundations, business or professional organizations.

The morning passes quickly in this research laboratory. Noon time comes and we prepare to leave for a look at a group of underprivileged children who are now under the Price nutritional reinforcement program. On the way to the Broadway Mission we pass through the Negro section. It is noon, on a winter day, in the slough of economic depression and unemployment. A group of colored people have congregated for some kind of meeting. Perhaps, a demonstration of the kind that is now taking place frequently in every industrial city in America. Swaggering police are breaking up the meeting. The atmosphere is sullen, ominous. This is another manifestation of malnutrition in which this day we are so vigorously interested.

The Broadway Methodist Church appears to be an ordinary church in a below-average neighborhood, but its pastor, the Reverend Edwin A. Brown, is an extraordinary character. To him the problems of physical disease, of hunger, of want are as im-

portant as his more spiritual pastoral duties. In the Mission of the church a group of poor children, who were selected because of rampant dental decay, are being fed a reinforced diet as practical experimentation of the control of dental caries. The scientific work is under the direction of Doctor Price; the practical and difficult job of supplying the food is the job of the Reverend Brown and his co-workers. One of these co-workers is a small, energetic young woman, Miss Flaherty, who resigned from a secretaryship in a church in a fashionable Cleveland suburb to carry on this and similar practical projects in the Broadway Mission. Another unsung co-worker is the cook, herself a mother, who works for a dollar a day at the Mission in preference to jobs that might pay more because "after the children are here a while they seem stronger and happier. I like to think that I am doing some good in the world."

Frazier Hunt in a vigorous article, "The Church Rolls Up Its Sleeves," in the March, 1933, issue of *Good Housekeeping* has this to say of the Reverend Brown and Doctor Price:

> About a year ago Rev. Brown was called to a poor home to baptize a child of four who had never recovered from an attack of infantile paralysis and only recently had fallen and broken his right thigh bone. His leg was still in a cast, and the poor little fellow simply was failing to make the grade. The minister postponed the baptism, and that afternoon while he was having his teeth fixed spoke about the sad case to the remarkable Dr. Weston A. Price, world authority on the relation of proper foods to teeth and bone. The kindly genius became interested, called on the boy, prescribed and furnished the means for a proper diet—and the other day, when I saw this child, he was as normal as any boy.
>
> Dr. Price was now interested in these children of the unemployed and, with the help of a volunteer corps of dentists, examined 750 school children and almost without exception found their teeth needed attention, and that they were not getting the proper tooth-building foods.
>
> Obviously there was not the means at hand to tackle the problem of caring for all these children. The next best thing was to pick out some 40 of the worst cases and give them free health luncheons. Dr. Price did this and from his own means supplied the cod-liver oil and a special butter rich in Vitamin D. The church group supplied the milk and whole-wheat biscuits and the wholesome simple food.

The children come from school. They line up and without protest each takes a teaspoonful of half and half high vitamin cod liver oil and high vitamin butter concentrate. This preparation supplies the organic catalysts that speed up the physiologic reaction whereby the minerals, particularly calcium and phosphorus, which are supplied in abundance in the food are utilized to supply the demands of the tissues.

The meal that we ate with these children was typical: a vegetable loaf, freshly made, muffins from freshly ground whole wheat, milk, high vitamin butter, a wheat pudding. The whole wheat, by the way, is ground in a mill in the basement of the church.

Because this is intended to be neither a scientific paper nor an interpretation of a research project, one hesitates to pass an opinion on the validity of Price's work. That day, though, we did see roentgenographic evidence to indicate the defense ability of the pulp to lay down a calcified wall to protect the pulp from the carious attack, and we *saw* and *heard* and *felt* carious dentine that was black, that gave off a high note from a metal explorer point, and that was hard. This dentine was of a character that we seldom meet in clinical practice. Those who wish may enter into controversy as to whether or not this nutritional reinforcement program checks the progress of dental caries.

We leave this experimental group in practical science and practical Christianity and return to the research laboratory. The broad, white staircase invites us to the second floor. Here are the biochemical laboratories; the sputtering Bunsen flames, the retorts, test tubes, row on row. In one room hangs a gigantic map of the world with pins marking the spots from which butter samples regularly come: from New Zealand and New Mexico, from Saskatchewan and Switzerland.

The postman has just left an armful of packages, each one alike in form and size, but each carrying a different postmark and some the stamps of foreign governments. These are the butter samples. Each is to be tested chemically or biologically for the amount of vitamin A and D. From these samples will be ordered the butter to be used in the preparation of the nutritional reinforcement material.

There are two other chemical laboratories on this floor, both in charge of trained biochemists. In one the work on blood chemistry is done by a short-pompadoured, meticulous chemist who speaks with the accent of Teutonic scholarship. In the other laboratory saliva specimens are tested by the new method described by Price which determines the degree of susceptibility or immunity to caries. In this room we gayly drooled into glass jars and later saw our saliva undergo the elaborate and complicated chemical tests.

In another room we saw the agricultural exhibit. Here are grasses, vegetables, fruits, and grains which had grown luxuriant in virile soil and under the clear sun. There are other vegetations, dwarfed and stunted, grown in depleted soils or under a shrouded sun. Man and his domestic animals eat these grains and fruits of the soil. Which ones they eat, from whence they sprang determine in a measure their degree of health. The study of foods is more than a problem in domestic science; vitamins more than a recitation of an alphabet of A's and B's and C's. Geology, geography, degrees of latitude and longitude—these have an important relationship to man and his foods and the diseases that attack him.

Twilight is closing in. We sit in a high-ceiling study with books and magazines all about us. It is a disorderly study where work is done; no precise library of ostentation. Here we see the voluminous data of experiments; the graphs and charts of evidence presented before the critical American Association for the Advancement of Science. And here we see and hear the human stories behind cold science. There is a brusque business-like letter from a wealthy man who has heard of these experiments and who offers to conduct any kind of an agricultural or dairy experiment in connection with this work and pay for it in entirety. Then there is a letter from a father, the kind of appreciative letter that we sometimes receive from thoughtful parents, describing how this treatment has helped his boy. It is not a letter of fulsome praise, not a testimonial; it is a simple, direct, kind letter that most of us would remember long after the fee is paid and spent.

The clatter of test tubes and flasks has ceased, the hum of patients in the reception room is stopped, blue flames no longer spring from the throats of the Bunsen burners. Evening has come.

We leave the red brick house. From out of Canada, across Lake Erie the wind sweeps in laden with snow.

—E.J.R.

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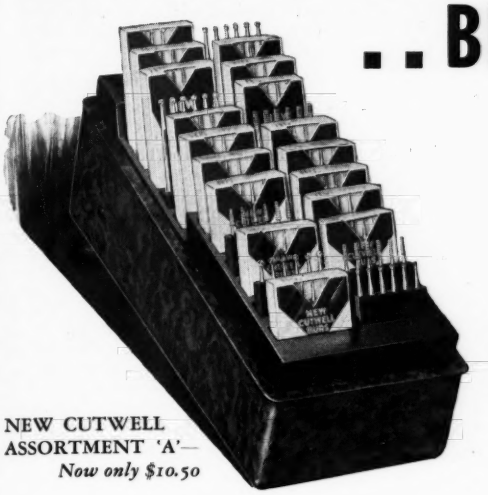

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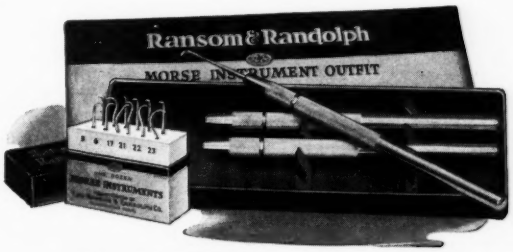

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LETTERS

I have been practicing for 13 years and last year was the first year to do without DIGEST, but I missed it and am now taking the new edition which I enjoy reading. The chart to show patients the stages of decay is interesting.—R. A. SPARKS, D.D.S., *Cuba, Kansas*

I wish to say that THE DENTAL DIGEST is always good and every issue contains something that is helpful to all dentists. The chart on dental conditions by Doctor Harris is excellent and very educational. I am glad to note he is to contribute more of them.—PETER A. FRANK, D.D.S., *Paterson, New Jersey*

Confidentially, I just can't get enthusiastic about THE DENTAL DIGEST since the change and must admit I'm disappointed. I would much rather pay $2.00 for *Oral Hygiene*. Some splendid articles in it, yes, but mostly pretty pictures. Pardon my frankness but this is my reaction and this is what most publishers want.—M.H.A., *Omaha, Nebraska*

Enclosed is a money order to cover my subscription for 1933. Congratulations on your new type of magazine. — FRED J. BRAXTON, D.D.S., *Chicago*

It would be a catastrophe to miss a single issue of your excellent publication.—CHARLES MCLEAN, D.D.S., *Toronto*

Through your illustrations, I believe you convey to the members of the profession and their patients a very valuable aid, both in diagnosis and technique of restoration, which is instructive and interesting. You have my best wishes for the continuance of your present policies.—ROBERT R. EBERSOLE, D.D.S., *Muskogee, Oklahoma*

I noticed in your February issue a formula for the treatment of novocaine dermatitis. Why should this treatment be necessary? I suffered terribly from novocaine dermatitis and spent a good bit of money on treatments, but nothing helped. I changed needles and syringes, solutions, etc., until I finally gave up in despair and decided to stop using novocaine entirely. Then I discovered that I wasn't becoming infected by the injections, because I used a mirror to hold the cheek and lip, but was infecting myself during the actual extraction. To make a long story short, I decided to use rubber gloves, but without success. I couldn't get the feel of the tooth with my whole hand covered. I now just use rubber fingers—on the index finger, thumb, and middle finger. The fourth and fifth fingers are left unguarded for easier manipulation.—RAYMOND R. KRAMER, D.D.S., *West Chester, Pennsylvania*

Your magazine stands far above any other dental publication. At last the dental profession has been offered something practical. — DIRK LOUBSER, D.D.S., *Lapeer, Michigan*

I wish to say that the first and second issues of THE DENTAL DIGEST have greatly impressed me by their colorful pictures of the various stages of dental restorations and different diseases, as well as the complete and detailed instructions to be followed by an up-to-date dental practitioner. It is so informative that I hate to miss one copy.

Your contributors should be congratulated on their effort to enlighten modern technique.—ADOLFO P. MAGDANGAL, D.D.S., *Sault Ste. Marie, Michigan*

I did not receive my February copy of THE DENTAL DIGEST. I have an unbroken file of the DIGEST for the last ten years which I prize very highly. Please give this your early attention. I would not miss a copy for a good deal.—R. R. HILLIS, L.D.S., D.D.S., *Elmira, Ontario*

It may interest you to know that I received correspondence about my article from New York to California and from Florida to Minnesota, and I honestly believe that you have the most thoroughly read dental journal published. — D. W. PHILLIPS, D.D.S., *Chicago*

I look forward to your journal every month as it has helped me in my practice. It is the outstanding magazine. Good luck and keep up the good work!—MEYER S. BAER, D.D.S., *Boston*

I look forward to receiving my DENTAL DIGEST every month and do not wish to miss an issue. — C. C. WHITE, D.D.S., *Windsor, Ontario*

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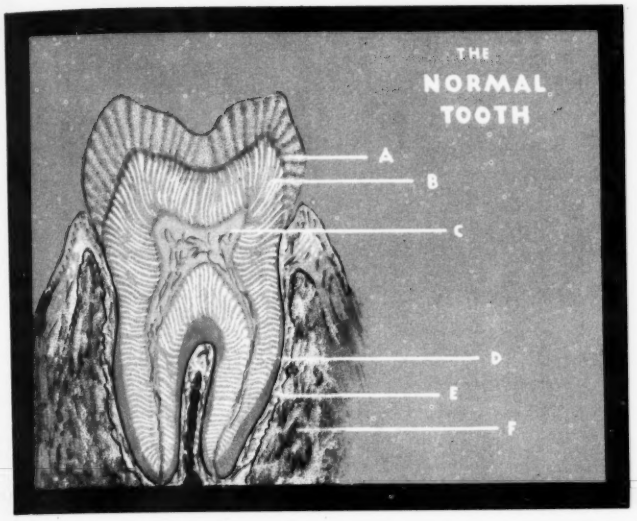
THE EDUCATION OF THE DENTAL PATIENT*

III. THE PROGRESS OF TOOTH DECAY



A. Enamel

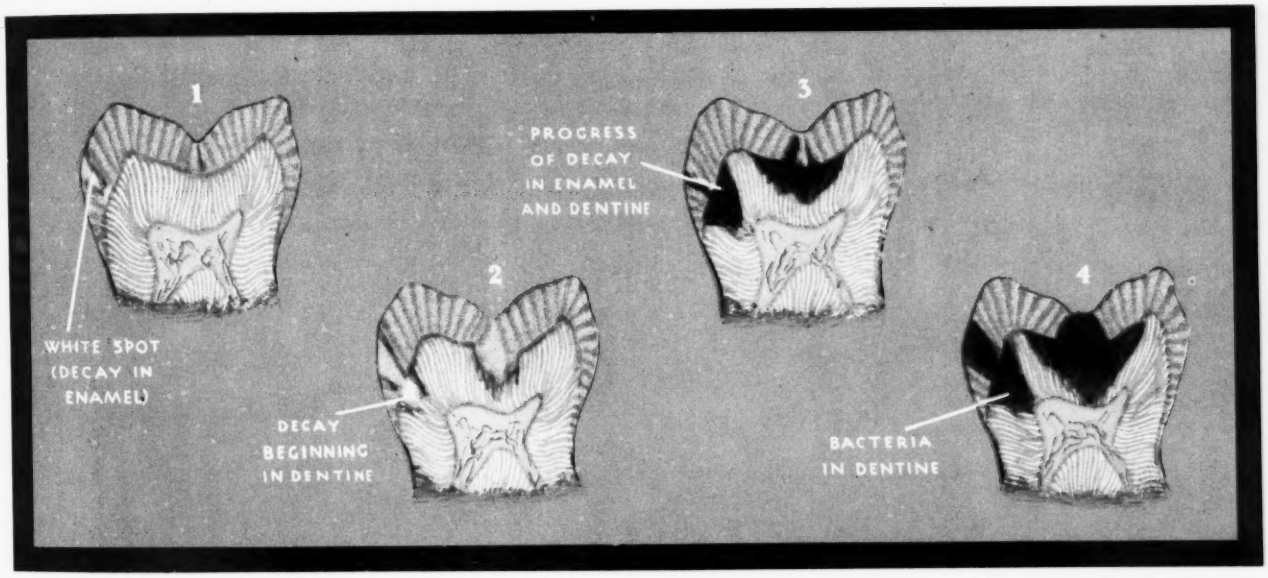
B. Dentine

C. Pulp

D. Cementum

E. Periodontal membrane

F. Bone



1. A small cavity in the enamel.
2. Decay extends to the dentine.
3. The tooth is being undermined; the surface cavity may not be large.
4. Bacteria have begun to penetrate the dentine.
5. Decay extends to the pulp (nerve) of the tooth——→

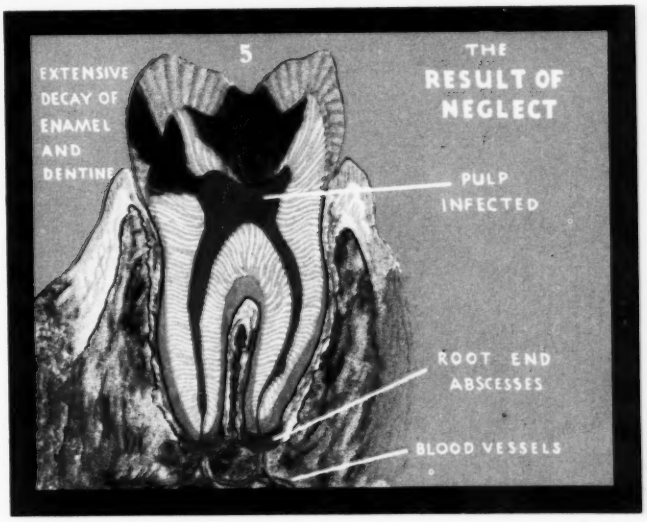
   The pulp becomes infected——→

   An abscess develops at the root-end——→

From this focus of infection bacteria are carried to distant parts of the body.

RESULT: General Systemic Disease.

RECOMMENDATION: Early Care of Small Cavities.



*This is the third chart in the series intended for the use of the dentist in explaining important normal and pathologic dental conditions to his patients.

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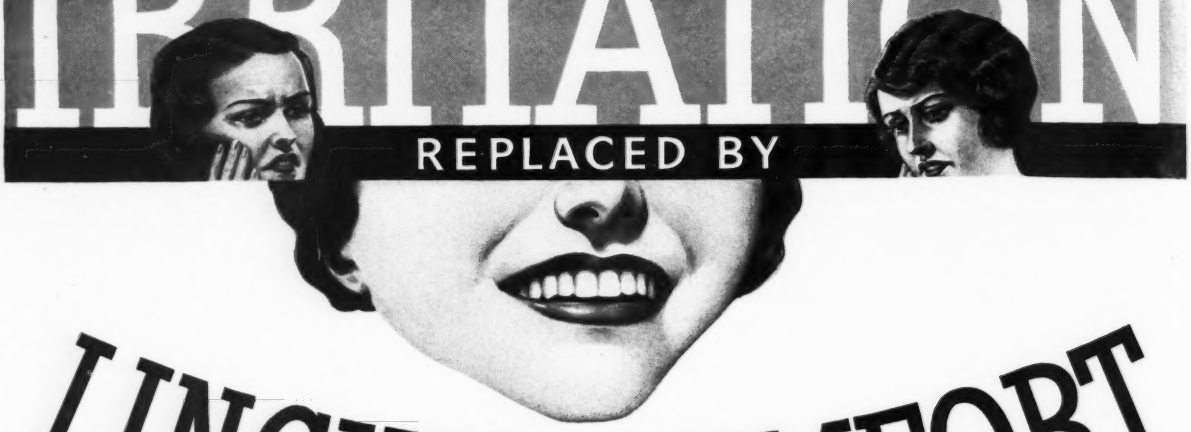

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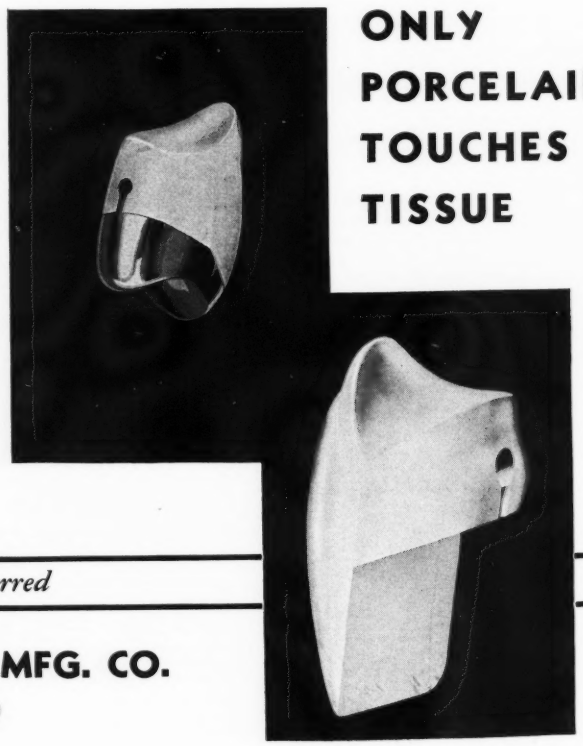

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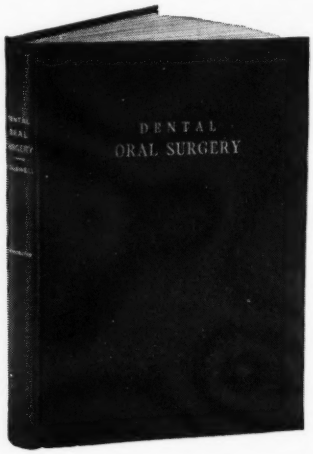

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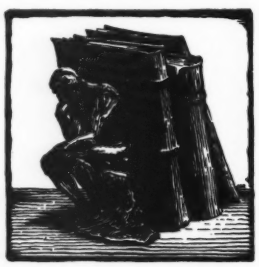

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Brittle Castings II

Brittle castings are sometimes caused by errors in casting technique. The two castings shown in the accompanying micrographs illustrate the effects of one such error.

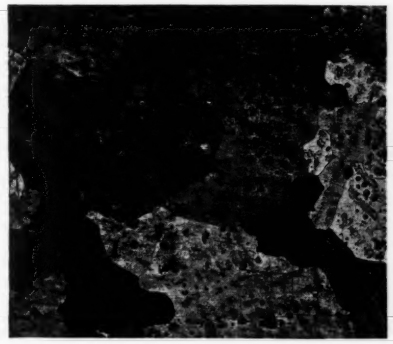

Fig. A—Section through a cast denture which cracked during finishing. The metal is very coarse grained and badly pitted, as indicated by small irregular dark spots throughout.

Fig. B—The same metal after remelting and casting properly. The metal is much finer grained and sounder. This casting was strong and tough.

Cause—The casting shown in Fig. A was made in an excessively hot mold (the bronze flask had started to melt) and the gold was heated to a very high temperature. The technician erroneously considered these measures necessary to insure a complete casting.

Effect—As a result the metal in the mold cooled and froze very slowly, producing a coarse-grained and consequently weak and brittle casting. The strength of the casting was still further impaired by abnormal porosity caused by oxidation and absorption of gases at the excessively high temperature.

Remedy—This casting was remelted on a charcoal block with reducing flux and a second casting, shown in Fig. B, was made without the addition of any new gold. Care was taken not to overheat the gold and the mold was heated to a dull red (1300°F). The very much smaller grain size is quite noticeable. The porosity, though somewhat greater than normal, probably because of the previous abusive treatment of the metal, is much less than in the original casting. This second casting was strong and tough.

Avoid overheating casting gold.

Avoid casting into excessively hot molds.

Many other helpful suggestions on casting technique are contained in The Gold Book, a copy of which will be sent on request.

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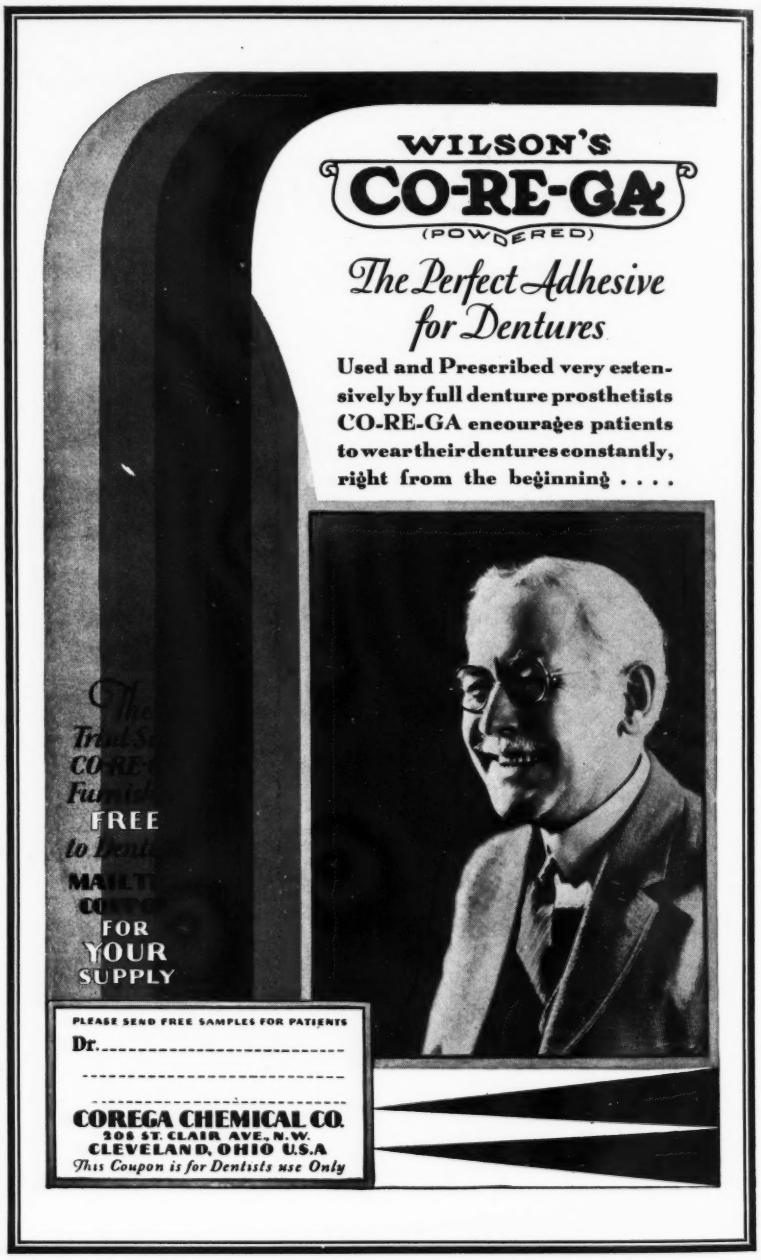
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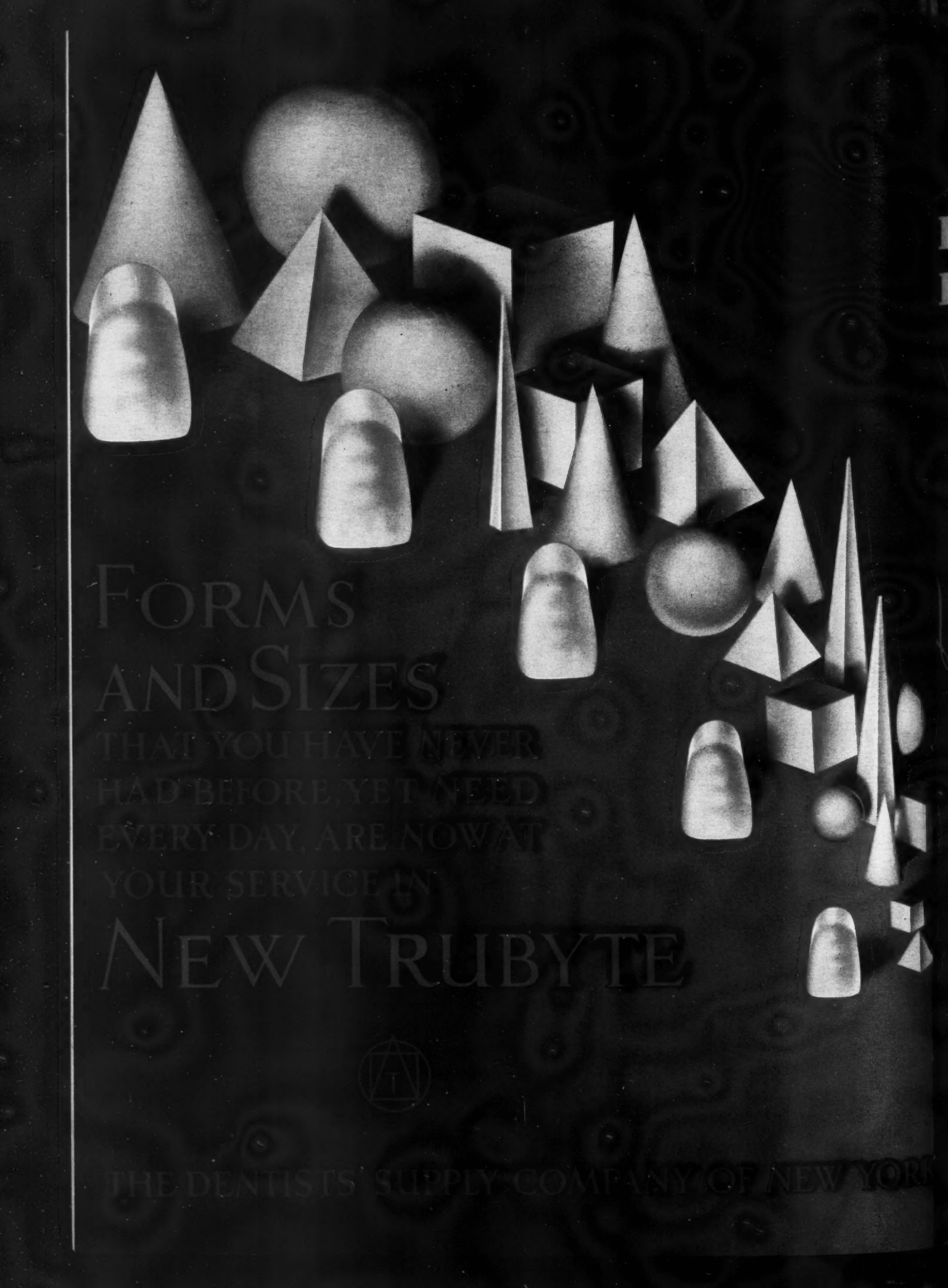
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